Quantum Ethernet I/O

Ethernet Remote I/O Modules
Installation and Configuration Guide

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Schneider Electric

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All pertinent state, regional, and local safety regulations must be observed when installing and using this product. For reasons of safety and to help ensure compliance with documented system data, only the manufacturer should perform repairs to components.

When devices are used for applications with technical safety requirements, the relevant instructions must be followed.

Failure to use Schneider Electric software or approved software with our hardware products may result in injury, harm, or improper operating results.

Failure to observe this information can result in injury or equipment damage.

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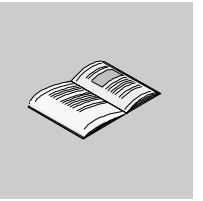
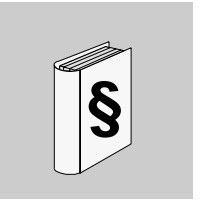


Safety Information



Important Information

NOTICE

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of this symbol to a Danger or Warning safety label indicates that an electrical hazard exists, which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

⚠ DANGER

DANGER indicates an imminently hazardous situation which, if not avoided, **will result in** death or serious injury.

⚠ WARNING

WARNING indicates a potentially hazardous situation which, if not avoided, **can result in** death or serious injury.

⚠ CAUTION

CAUTION indicates a potentially hazardous situation which, if not avoided, **can result in** minor or moderate injury.

CAUTION

CAUTION, used without the safety alert symbol, indicates a potentially hazardous situation which, if not avoided, **can result in** equipment damage.

PLEASE NOTE

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

A qualified person is one who has skills and knowledge related to the construction and operation of electrical equipment and its installation, and has received safety training to recognize and avoid the hazards involved.

BEFORE YOU BEGIN

Do not use this product on machinery lacking effective point-of-operation guarding. Lack of effective point-of-operation guarding on a machine can result in serious injury to the operator of that machine.

⚠ WARNING

UNGUARDED MACHINERY CAN CAUSE SERIOUS INJURY

- Do not use this software and related automation equipment on equipment which does not have point-of-operation protection.
- Do not reach into machinery during operation.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

This automation equipment and related software is used to control a variety of industrial processes. The type or model of automation equipment suitable for each application will vary depending on factors such as the control function required, degree of protection required, production methods, unusual conditions, government regulations, etc. In some applications, more than one processor may be required, as when backup redundancy is needed.

Only the user can be aware of all the conditions and factors present during setup, operation, and maintenance of the machine; therefore, only the user can determine the automation equipment and the related safeties and interlocks which can be properly used. When selecting automation and control equipment and related software for a particular application, the user should refer to the applicable local and national standards and regulations. The National Safety Council's Accident Prevention Manual (nationally recognized in the United States of America) also provides much useful information.

In some applications, such as packaging machinery, additional operator protection such as point-of-operation guarding must be provided. This is necessary if the operator's hands and other parts of the body are free to enter the pinch points or other hazardous areas and serious injury can occur. Software products alone cannot protect an operator from injury. For this reason the software cannot be substituted for or take the place of point-of-operation protection.

Ensure that appropriate safeties and mechanical/electrical interlocks related to point-of-operation protection have been installed and are operational before placing the equipment into service. All interlocks and safeties related to point-of-operation protection must be coordinated with the related automation equipment and software programming.

NOTE: Coordination of safeties and mechanical/electrical interlocks for point-of-operation protection is outside the scope of the Function Block Library, System User Guide, or other implementation referenced in this documentation.

START-UP AND TEST

Before using electrical control and automation equipment for regular operation after installation, the system should be given a start-up test by qualified personnel to verify correct operation of the equipment. It is important that arrangements for such a check be made and that enough time is allowed to perform complete and satisfactory testing.

⚠ CAUTION

EQUIPMENT OPERATION HAZARD

- Verify that all installation and set up procedures have been completed.
- Before operational tests are performed, remove all blocks or other temporary holding means used for shipment from all component devices.
- Remove tools, meters, and debris from equipment.

Failure to follow these instructions can result in injury or equipment damage.

Follow all start-up tests recommended in the equipment documentation. Store all equipment documentation for future references.

Software testing must be done in both simulated and real environments.

Verify that the completed system is free from all short circuits and grounds, except those grounds installed according to local regulations (according to the National Electrical Code in the U.S.A, for instance). If high-potential voltage testing is necessary, follow recommendations in equipment documentation to prevent accidental equipment damage.

Before energizing equipment:

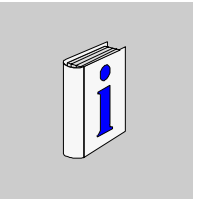
- Remove tools, meters, and debris from equipment.
- Close the equipment enclosure door.
- Remove ground from incoming power lines.
- Perform all start-up tests recommended by the manufacturer.

OPERATION AND ADJUSTMENTS

The following precautions are from the NEMA Standards Publication ICS 7.1-1995 (English version prevails):

- Regardless of the care exercised in the design and manufacture of equipment or in the selection and ratings of components, there are hazards that can be encountered if such equipment is improperly operated.
- It is sometimes possible to misadjust the equipment and thus produce unsatisfactory or unsafe operation. Always use the manufacturer's instructions as a guide for functional adjustments. Personnel who have access to these adjustments should be familiar with the equipment manufacturer's instructions and the machinery used with the electrical equipment.
- Only those operational adjustments actually required by the operator should be accessible to the operator. Access to other controls should be restricted to prevent unauthorized changes in operating characteristics.

About the Book



At a Glance

Document Scope

PlantStruxure is a Schneider Electric program specifically designed to address the key challenges of many different types of users — including plant managers, operations managers, engineers, maintenance teams, and operators — by delivering a system that is scalable, flexible, integrated, and collaborative.

This document presents one of the PlantStruxure features — using Ethernet as the backbone around the Quantum PLC offer and connecting a *Quantum local rack* to *remote I/O drops*. This feature is known as Quantum Ethernet I/O or Quantum EIO.

This guide describes these modules and their roles in a Quantum EIO system:

- 140 CRP 312 00: head module on the local rack in a remote I/O main ring
- 140 CRA 312 00: adapter module in the remote I/O drop

NOTE: The specific configuration settings contained in this guide are for instructional purposes only. The settings required for your specific application may differ from the examples presented in this guide.

Validity Note

This document is valid for Unity Pro 6.0 or later.

The technical characteristics of the device(s) described in this manual also appear online. To access this information online:

Step	Action
1	Go to the Schneider Electric home page *www.schneider-electric.com*.
2	In the **Search** box type the model number of a product or the name of a product range. ● Do not include blank spaces in the model number/product range. ● To get information on a grouping similar modules, use asterisks (*).

Step	Action
3	If you entered a model number, go to the **Product datasheets** search results and click on the model number that interests you. If you entered the name of a product range, go to the **Product Ranges** search results and click on the product range that interests you.
4	If more than one model number appears in the **Products** search results, click on the model number that interests you.
5	Depending on the size of your screen, you may need to scroll down to see the data sheet.
6	To save or print a data sheet as a .pdf file, click **Download *XXX* product datasheet**.

The characteristics presented in this manual should be the same as those that appear online. In line with our policy of constant improvement we may revise content over time to improve clarity and accuracy. In the event that you see a difference between the manual and online information, use the online information as your reference.

Related Documents

Title of Documentation	Reference Number
Quantum Ethernet I/O System Planning Guide	S1A48959 (English), S1A48961 (French), S1A48962 (German), S1A48964 (Italian), S1A48965 (Spanish), S1A48966 (Chinese)
Modicon Quantum Change Configuration on the Fly User Guide	S1A48967 (English), S1A48968 (French), S1A48969 (German), S1A48970 (Italian), S1A48972 (Spanish), S1A48976 (Chinese)
Modicon Quantum Hot Standby System User Manual	35010533 (English), 35010534 (French), 35010535 (German), 35013993 (Italian), 35010536 (Spanish), 35012188 (Chinese).

Unity Pro Program Languages and Structure Reference Manual	35006144 (English), 35006145 (French), 35006146 (German), 35006147 (Spanish), 35013361 (Italian), 35013362 (Chinese)
Unity Pro Operating Modes	33003101 (English), 33003102 (French), 33003103 (German), 33003104 (Spanish), 33003696 (Italian), 33003697 (Chinese)
Quantum with Unity Pro Hardware Reference Manual	35010529 (English), 35010530 (French), 35010531 (German), 35010532 (Spanish), 35013975 (Italian), 35012184 (Chinese)
Unity Pro Installation Manual	35014792 (French), 35014793 (English), 35014794 (German), 35014795 (Spanish), 35014796 (Italian), 35012191 (Chinese)

You can download these technical publications and other technical information from our website at www.schneider-electric.com.

User Comments

We welcome your comments about this document. You can reach us by e-mail at techcomm@schneider-electric.com.

Characteristics of Ethernet Remote I/O Modules

1

Introduction

This chapter describes the head and adapter modules for Ethernet remote I/O communications in a Quantum EIO system. Specifically, those modules are:

- 140 CRP 312 00: head module on a local Quantum rack
- 140 CRA 312 00: adapter module on an Ethernet remote I/O rack

This chapter includes physical characteristics, port descriptions, and agency specifications for these modules.

What's in this Chapter?

This chapter contains the following topics:

140 CRP 312 00 Module Description

Introduction

The 140 CRP 312 00 Quantum module is the head module on the main rack of Quantum Ethernet I/O installations. This module allows the PLC to connect to an Ethernet network and control remote I/O devices.

Functionality

The main purpose of the 140 CRP 312 00 module is to provide I/O scanning services of remote I/O devices on either a remote I/O network or a device network, which contains remote I/O and distributed I/O devices. The module is directly connected to the remote I/O network main ring, and it manages the remote I/O network through a daisy chain loop topology. This module also provides various Ethernet services, such as configuration for remote I/O devices and diagnostics.

You can use these function blocks with the 140 CRP 312 00 module:

- IU_ERIO
- DROP
- XDROP

Only one 140 CRP 312 00 module can be configured on the local rack. This module has interfaces for communicating with Ethernet remote I/O devices on the network.

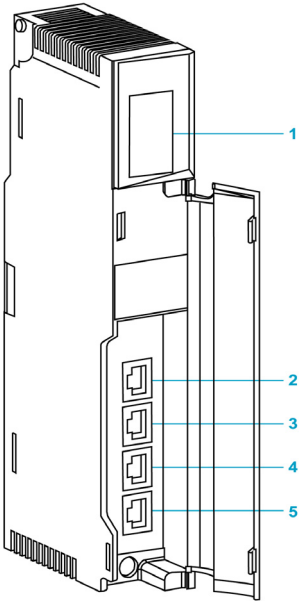
The 140 CRP 312 00 module allows the PLC to connect to an Ethernet network and to have a deterministic I/O exchange with modules in the Ethernet remote I/O drops.

The 140 CRP 312 00 module is dedicated to the management of remote I/O devices only. Other services of the 140 CRP 312 00 module:

- The module uses RSTP to enable all remote I/O devices on the main ring to recover from a communication disruption within 50 ms.
- The module can configure IP parameters and the configurations for I/O modules on the drops for up to 31 remote I/O devices.
- The module provides a communication path (through an interlink) to allow distributed I/O and control network traffic to participate on the remote I/O network.
- The module supports Hot Standby functionality. The primary 140 CRP 312 00 module and the standby 140 CRP 312 00 module do not swap their IP addresses when a switchover occurs.

External Features

140 CRP 312 00:



1 LED display
2 SERVICE port (ETH 1)
3 INTERLINK port (ETH 2)
4 DEVICE NETWORK port (ETH 3)
5 DEVICE NETWORK port (ETH 4)

External Ports

The 140 CRP 312 00 module monitors the functionality of network links depending on which links are connected to the network. The module has 4 external ports (but only 1 IP address):

Port	Quantity	Description
SERVICE	1	The SERVICE port allows the diagnosis of Ethernet ports and provides access to external tools and devices (Unity Pro, ConneXview, HMI, etc.). The port supports these modes: ● access port (default): This mode supports Ethernet communications. ● port mirroring: In this mode, data traffic from one or more of the other 3 ports is copied to this port. This allows a connected tool to monitor and analyze the port traffic. ● disabled **NOTE:** ● Do not connect a device with a speed in excess of 100 Mbps to the SERVICE port. If the device is configured for a speed that exceeds 100 Mbps, the Ethernet link may not be established between the device and the module through the SERVICE port. ● You can configure the SERVICE port either on line or off line. ● In port mirroring mode, the SERVICE port acts like a read-only port. That is, you cannot access devices (ping, connection to Unity Pro, etc.) through the SERVICE port. Refer to *Service Port Configuration (see page 56)*.
INTERLINK	1	The INTERLINK port provides connectivity to other Quantum EIO modules.
DEVICE NETWORK	2	These 2 copper ports provide: ● connections for remote I/O communications ● cable redundancy via the daisy chain loop architecture

140 CRA 312 00 Module Description

Introduction

A 140 CRA 312 00 module is the adapter module located in any Quantum Ethernet I/O installation. A remote I/O drop can be connected directly to the main ring cable or to a sub-ring cable.

Functionality

The 140 CRA 312 00 Quantum module exchanges data with the remote I/O head module 140 CRP 312 00.

Features:

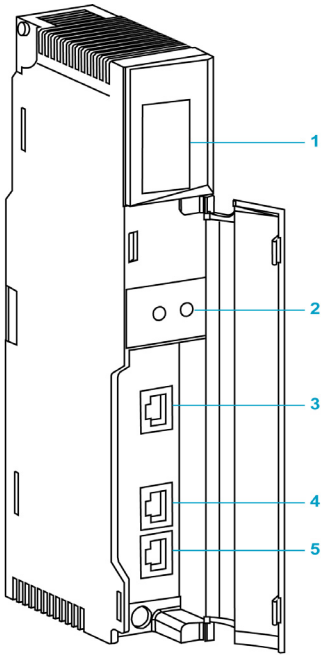
- The input data from the Ethernet remote I/O drop is collected and published to the remote I/O scanner.
- The output modules are updated with the data received from the remote I/O scanner.
- The protocol used for exchange is EtherNet/IP.
- The remote I/O scanner views the 140 CRA 312 00 module as a remote I/O adapter.
- The exchanges are deterministic, which means that the time it takes to resolve a remote I/O logic scan is predictable.

The 140 CRA 312 00 module has 3 external Ethernet ports and, therefore, 3 MAC addresses (but only 1 IP address). Two of the Ethernet ports allow implicit I/O exchanges with a remote I/O scanner adapter. (An implicit I/O exchange has a maximum frame size of 1400 bytes.) The ports can be implemented alone or in redundant mode.

You can use a maximum of 31 adapter modules (140 CRA 312 00) in a single Ethernet remote I/O network. For network topology planning, refer to the PlantStruxure Quantum Ethernet I/O System Planning Guide for more details of these topologies.

External Features

140 CRA 312 00:



1 LED display
2 rotary switches
3 SERVICE port (ETH 1)
4 DEVICE NETWORK port (ETH 2)
5 DEVICE NETWORK port (ETH 3)

External Ports

This module has three 10/100 Base-T Ethernet ports:

Port	Description
SERVICE	The SERVICE port allows the diagnosis of Ethernet ports and provides access to external tools and devices (Unity Pro, ConneXview, HMI, etc.). The port supports these modes: • access port (default): This mode supports Ethernet communications. • port mirroring: In this mode, data traffic from one of the other 3 ports is copied to this port. This allows a connected management tool to monitor and analyze the port traffic. • disabled **NOTE:** • Do not connect a device with a speed in excess of 100 Mbps to the SERVICE port. If the device is configured for a speed that exceeds 100 Mbps, the Ethernet link may not be established between the device and the module through the SERVICE port. • You can configure the SERVICE port either on line or off line. • In port mirroring mode, the SERVICE port acts like a read-only port. That is, you cannot access devices (ping, connection to Unity Pro, etc.) through the SERVICE port. Refer to *Service Port Configuration (see page 56)*.
DEVICE NETWORK	The 2 DEVICE NETWORK copper ports provide: • connections for remote I/O communications • cable redundancy

Cable Redundancy

Use a daisy chain network configuration that implements the RSTP service to establish redundant communications between the 140 CRA 312 00 module and a remote I/O scanner. The module operates normally when at least one of the 2 physical paths to the 140 CRP 312 00 is valid. (Refer to the PlantStruxure Quantum Ethernet I/O System Planning Guide for more details of these topologies.)

Module Specifications

Product Certification

The Quantum remote I/O modules for Quantum EIO meet these standards:

UL (UL508)
CSA (CSA22.2 no. 142)
C-tick
Hazardous locations (Cl1 div 2)
IEC61000-4-16
EMI EN 55011
CE
EN 61131-1
IEC 61131-2 (zone B and zone C, except surges on AC: zone B only)

Quantum EIO modules conform to these product certification and marine classification authorities:

Key	Certification Body	Country
ABS	American Bureau of Shipping	United States
BV	Bureau Veritas	France
DNV	Det Norske Veritas	Norway
GOST	Gosudarstvennyy Standart	Russia
GL	Germanischer Lloyd	Germany
LR	Lloyd's Register	United Kingdom
RINA	Registro Italiano Navale	Italy

The electrical isolation within Quantum EIO system modules complies with the 1500 Vac/2250 Vdc 60s from IEEE 802.3 2008.

Environmental Requirements

Parameter	Reference	Specification
protection	EN 61131-2	IP20
	IEC 60527	
protection class	EN 61131-2	protection class 1
over voltage class	EN 61131-2	category II

Parameter	Reference	Specification
operating temperature	IEC 60068-2-1	0 ... 60° C
	Ab&Ad (cold)	
	IEC 60068-2-2	
	Bb&Bd (cold)	
storage temperature	IEC 60068-2-1	-40 ... 85° C
	Ab&Ad (cold)	
	IEC 60068-2-2	
	Bb&Bd (cold)	
sinusoidal vibration	IEC 60068-2-6fC	• .5 ... 8.4 Hz at 3.5 mm constant amplitude • 8.4 ... 150 Hz at 1g constant acceleration • 10 cycles at sweep rate of 1 oct/min
	EN 61131-2	
operating shock	IEC 60068-2-27Ea	30 g peak, 11 ms, half-sine wave, 3 shocks in each direction (+ and -) for each of the 3 principle axes
altitude	(operating)	2000 m
	(transport)	3000 m
free fall, random (packaged)	EN 61131-2	5 random drops from 1 m onto flat surfaces
	IEC 60068-2-32	
	test ed., method 1	
free fall, flat drop (unpackaged)	EN 61131-2	• 2 random drops from 1 m onto flat surfaces • 5 drops from 0.1 m onto flat surfaces
	IEC 60068-2-32	
	test ed., method 1	
free fall, angled (unpackaged)	EN 61131-2	5 drops from 0.1 m onto each corner
	IEC 60068-2-31	
relative humidity (operating)	IEC 60068-2-78Ca	93% (+/- 2%, noncondensing) at 60° C
relative humidity (nonoperating)	IEC 60068	93% (+/- 2%, noncondensing) at 60° C

I/O Devices

Introduction

This topic lists the I/O devices that can be connected to an Ethernet remote I/O network.

Analog and Digital Modules

These analog and digital I/O modules are supported in remote I/O drops:

Input	Output	Input/Output
Analog I/O Modules:		
140 ACI 030 00	140 ACO 020 00	140 AMM 090 00
140 ACI 040 00	140 ACO 130 00	
140 AII 330 00	140 AIO 330 00	
140 AII 330 10	140 AVO 020 00	
140 ARI 030 10		
140 ATI 030 00		
140 AVI 030 00		

Input	Output	Input/Output
Digital I/O Modules:		
140 DDI 153 10	140 DDO 153 10	140 DDM 390 00
140 DDI 353 00	140 DDO 353 00	140 DDM 690 00
140 DDI 353 10	140 DDO 353 01	140 DAM 590 00
140 DDI 364 00	140 DDO 353 10	
140 DDI 673 00	140 DDO 364 00	
140 DDI 841 00	140 DDO 843 00	
140 DDI 853 00	140 DDO 885 00	
140 DAI 340 00	140 DAO 840 00	
140 DAI 353 00	140 DAO 840 10	
140 DAI 440 00	140 DAO 842 10	
140 DAI 453 00	140 DAO 842 20	
140 DAI 540 00	140 DAO 853 00	
140 DAI 543 00	140 DRA 840 00	
140 DAI 553 00	140 DRC 830 00	
140 DAI 740 00	140 DVO 853 00	
140 DAI 753 00	140 DIO 330 00	
140 DII 330 00		
140 DSI 353 00		

Intelligent and Special Purpose Modules

These intelligent/special purpose modules are supported in remote I/O drops:

Type	Module
expert	140 ERT 854 10
	140 ESI 062 10
counting	140 EHC 105 00
	140 EHC 202 00
communication	140 XBE 100 00

Installation

2

Overview

This chapter describes the hardware installation of a Quantum EIO system. It includes the installation of modules in the local rack and the Ethernet remote I/O drop to which it is connected. Other discussions include the interconnections between rack-mounted modules and the hardware considerations for different PLC platforms.

What's in this Chapter?

This chapter contains the following sections:

2.1 Installing Quantum Ethernet I/O Modules on a Quantum Rack

Introduction

This section describes the installation of these Quantum Ethernet I/O modules:

- 140 CRP 312 00 head module (on the main rack)
- 140 CRA 312 00 adapter (on the remote drop)

What's in this Section?

This section contains the following topics:

Installing the Quantum Controller

Introduction

For any Quantum Ethernet I/O system, install a Quantum controller on the main rack. Only processors with firmware version 3.0 or higher are compatible with Quantum Ethernet I/O installations.

Compatible Processors

Compatible processors:

Processor Type	Part
standalone	140 CPU 651 50
	140 CPU 651 60
	140 CPU 652 60
Hot Standby	40 CPU 671 60
	140 CPU 672 61

NOTE: Low-end Quantum processors (140 CPU 434 12U, 140 CPU 534 14U, 140 CPU 311 10) and Quantum safety processors (140 CPU 651 60S, 140 CPU 671 60S) are not compatible with Quantum Ethernet I/O systems.

Selecting a Power Supply

When installing a Quantum controller, add a power supply module that is capable of supplying power to all modules on the rack.

Mounting a Quantum Ethernet I/O Module on the Backplane

Introduction

Use these steps to installation these Quantum Ethernet I/O modules on the Quantum rack:

- 140 CRP 312 00 head module (on the main rack)
- 140 CRA 312 00 adapter (on the remote drop)

Considerations

Do not apply power to a Quantum rack until connections are made at both ends of the Ethernet cable. For example, connect the cable to both the 140 CRP 312 00 and another device (140 CRA 312 00 or DRS) before you turn on the power.

⚠ DANGER

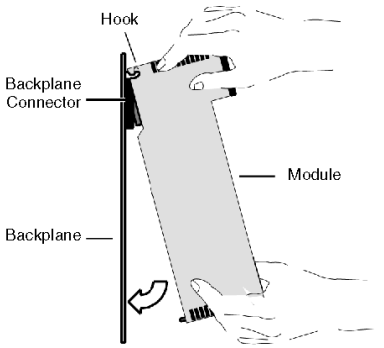
ELECTRICAL SHOCK HAZARD

- Switch off the power supply to the automation controller stations at both ends of the connection before inserting or removing an Ethernet cable.
- Use suitable insulation equipment when inserting or removing all or part of this equipment.

Failure to follow these instructions will result in death or serious injury.

Use fiber-optic cable to establish a communications link when it is not possible to master potential between distant grounds.

Mounting a Module

Step	Action
1	Hold the module at an angle and mount it on the 2 hooks near the top of the backplane. The figure shows the correct way to hold the module: 
2	Swing the module down so the connector engages the backplane connector.
3	Use a Phillips-head screw driver to tighten the screw at the bottom of the module from 2 to 4 in-lbs or from .22 through .45 N•m of torque.

Replacing a Module

You can replace a Quantum Ethernet I/O module at any time using another module with compatible firmware. The replacement module obtains its operating parameters over the backplane connection from the CPU. The transfer occurs immediately at the next cycle to the device.

The operating parameters that the CPU sends to a replacement module do not include any parameter values that were edited in the original module using explicit messaging **SET** commands.

Quantum Ethernet I/O Module Installation Considerations

Introduction

Observe the guidelines below when you install these Quantum Ethernet I/O modules:

- 140 CRP 312 00 head module (on the main rack)
- 140 CRA 312 00 adapter (on the remote drop)

Grounding Considerations

⚠ DANGER

ELECTRICAL SHOCK HAZARD

- Switch off the power supply to the automation controller stations at both ends of the connection before inserting or removing an Ethernet cable.
- Use suitable insulation equipment when inserting or removing all or part of this equipment.

Failure to follow these instructions will result in death or serious injury.

Use fiber-optic cable to establish a communications link when it is not possible to master potential between distant grounds.

NOTE: Refer to the ground connections information in the *Grounding and Electromagnetic Compatibility of PLC Systems User Manual*.

Installation

You can apply power to the Quantum Ethernet I/O controller rack after the 140 CRP 312 00 or 140 CRA 312 00 module is inserted:

- Successful installation:
  - Intialization is finished.
  - Interconnections to other modules are validated (140 CRP 312 00 only).
- Unsuccessful installation:
  - Initialization does not finish.
  - Interconnections to other modules are not validated (140 CRP 312 00 only).

You can see the status of the installation on the LED display *(see page 93)*.

NOTE: These guidelines pertain to the installation of a single 140 CRP 312 00 or 140 CRA 312 00 module, not the entire network. For network power-up guidelines, refer to the PlantStruxure Quantum Ethernet I/O System Planning Guide.

Remote I/O Network Cable Installation

Introduction

Your application can include:

- communications with a simple remote I/O daisy chain loop
- communications with a mix of remote I/O and distributed I/O networks

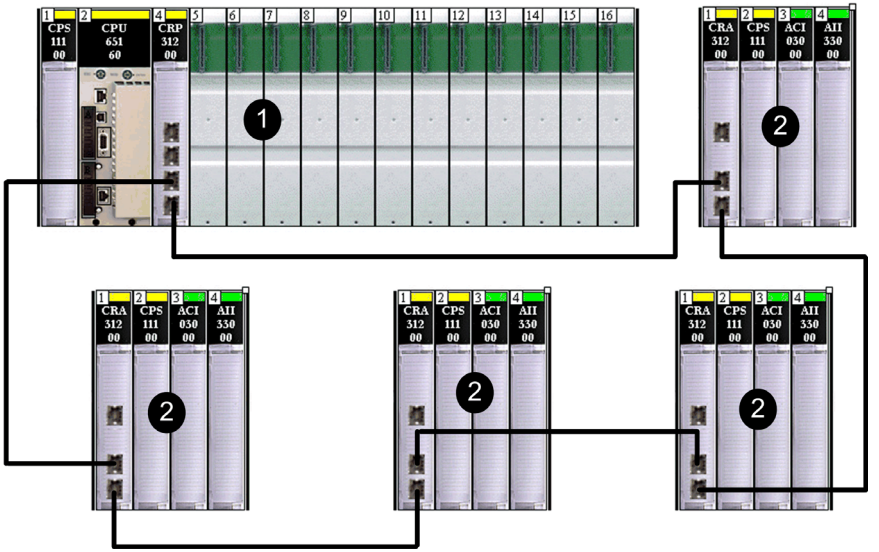
The cable connections to the 140 CRP 312 00 module on the local rack are different in these scenarios. They are discussed below.

Each Device Network port on the 140 CRP 312 00 head module is connected to the main ring of the daisy chain. Likewise, each Device Network port on a 140 CRA 312 00 adapter module is connected to a Quantum Ethernet I/O device. The 140 CRP 312 00 head module and the 140 CRA 312 00 adapter module do not have fiber-optic ports.

The Ethernet ports are clearly labeled *(see page 15)* on the 140 CRP 312 00 head module and the 140 CRA 312 00 adapter module.

Simple Remote I/O Daisy Chain Loop

The 140 CRP 312 00 supports communications with Ethernet remote I/O drops in daisy chain loops:



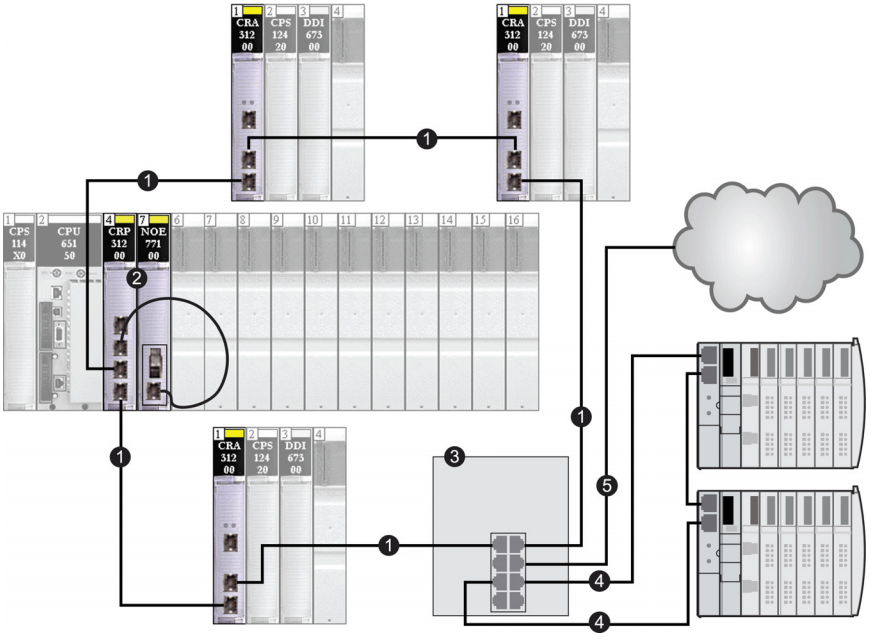
1 140 CRP 312 00 head module on the local rack
2 140 CRA 312 00 adapter module on a remote I/O drop

When you support only remote I/O, you do not have to link the 140 CRP 312 00 module to other communication modules on the local rack.

Mix of Remote I/O Drops, Distributed I/O Devices, and Clouds

The Quantum Ethernet I/O architecture allows distributed I/O devices to participate directly on the remote I/O network. This can be useful if, for example, you want to integrate a SCADA or HMI panel or some other kind of non-Quantum device into the remote I/O network.

Distributed I/O devices cannot be connected directly to the main ring of the remote I/O network, but they can be connected via a DRS. Most DRS preconfigurations enable some switch ports to support distributed I/O clouds:



1 main ring
2 140 CRP 312 00 interlinked to 140 NOE 771 •• module on the local rack
3 DRS
4 DRS connection to distributed I/O sub-ring
5 DRS connection to distributed I/O cloud

Some DRS preconfigurations support the connection of distributed I/O devices connected directly to a sub-ring. In these configurations, the distributed I/O devices have the advantage of cable redundancy provided by the sub-ring loop. In order for a distributed I/O device to operate on a sub-ring, it must have two Ethernet ports and support RSTP.

The above figure shows 2 STB islands used as distributed I/O devices on a sub-ring. The network interface module installed in each island is an STB NIP 2311 NIM, which has dual Ethernet ports and the RSTP service.

2.2 Installing the 140 CRA 312 00 on the Remote Drop

Introduction

This section describes the installation of the Quantum 140 CRA 312 00 module in an Ethernet remote I/O drop.

What's in this Section?

This section contains the following topics:

Installing the 140 CRA 312 00 Module

Locate a Backplane Slot

The 140 CRA 312 00 adapter module can be inserted in any slot in the remote I/O drop. Refer to the directions for installing a Quantum module on the backplane *(see page 30)*.

Power Consumption

Power consumption is 1.2 A on 3.3 Vdc power rail of the backplane (4 W). The 140 CRA 312 00 module supports Quantum modules on 1 or 2 racks. Each rack supports 16 slots. (Power consumption has no relation to the number of installed rack modules.)

Select a Power Supply

When configuring the PLC station, use a power supply module that is capable of supplying power to all rack modules.

Install a Quantum power supply module in to any slot on the Quantum rack. The selected power module should be suited to your unique system requirements. These modules (and their conformally coated versions) are supported:

Power Supply Type	Part
standalone	140 CPS 211 00 (C)
	140 CPS 511 00 (C)
	140 CPS 111 00 (C)
summable	140 CPS 214 00 (C)
	140 CPS 414 00 (C)
	140 CPS 114 20 (C)
redundant	140 CPS 224 00 (C)
	140 CPS 424 00 (C)
	140 CPS 524 00 (C)
	140 CPS 124 20 (C)

Installing Ethernet Remote I/O Drops on a Quantum Rack

Introduction

Use these guidelines to install Ethernet remote I/O drops on Quantum racks.

Racks and Extensions

An Ethernet remote I/O drop can include 1 or 2 racks. In a 2-rack drop, the racks are linked with the Quantum 140 XBE 100 00 bus extender module and the associated 140 XCA 717 0• cables (1 to 3 m).

Maximum configuration:

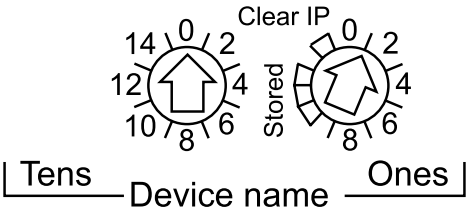
Module	Quantity
140 CRA 312 00 rack module	1
power supply module	2*
bus extension modules	2
I/O modules	27
*A separate power supply is required for each rack.	

Elsewhere in this guide is a list of modules that remote I/O installations support *(see page 24)*.

Setting the Location of the Ethernet Remote I/O Drop

Setting Rotary Switches

Set the location of the Ethernet remote I/O drop on the network with the rotary switches on the front of the 140 CRA 312 00 module before you apply power to the module and before you download the application:



The values you set are applied during a power cycle. If you change the setting of the rotary switches after the module has powered up, the Mod Status LED *(see page 93)* is activated, and a mismatch message is logged in the module diagnostic.

Because new values on the rotary switches are implemented only at the next power cycle, we recommend that you set the value before starting the module. (Valid values: 00 ... 159)

The values on the rotary switches combine with the device prefix (for example, 140CRA_) to create the device name *(see page 60)*. The above figure shows the Tens switch set to 0 and the Ones switch set to 01, for a device name of 140CRA_001.

NOTE:

- The rotary switches can be manipulated with a small flat-tipped screwdriver.
- No software is required to configure or enable the rotary switches.
- Do not use the Stored and Clear IP settings on the Ones rotary switch. (The functionality of these settings does not apply to remote I/O installations.)

2.3 Remote I/O Infrastructure Cables

What's in this Section?

This section contains the following topics:

Cable Installation

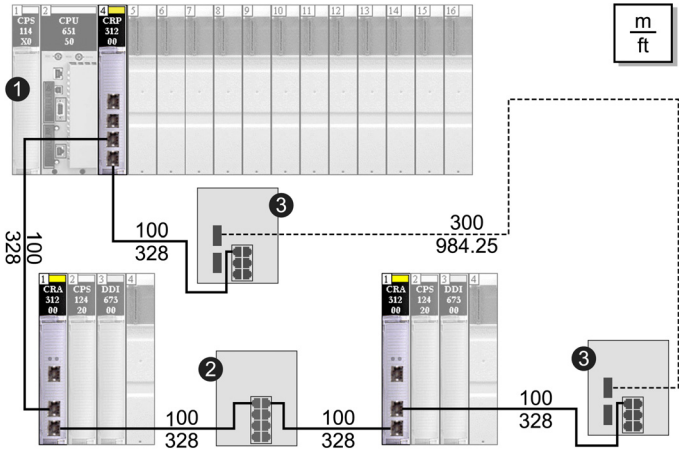
Introduction

Observe these guidelines when making cable connections between remote I/O devices on a Quantum Ethernet I/O installation. (Remote I/O devices include local racks, remote I/O drops, or DRSs.)

The distance between 2 consecutive remote I/O devices that are connected by copper cables cannot exceed 100 m. The distance between 2 consecutive remote I/O devices that are connected by fiber cables cannot exceed 15 km.

Connections Between Devices

This figure shows the distances between remote I/O devices in Quantum Ethernet I/O installations:



1 main rack: This rack includes a 140 CRP 312 00 head module that supports remote I/O communications.

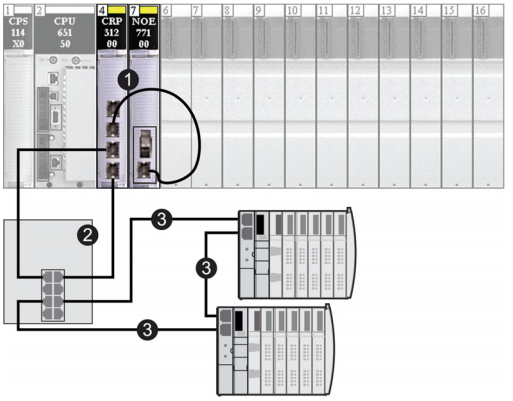
2 DRS (with copper ports): This DRS serves to extend the distance between other devices.

3 DRS (with copper and fiber ports): This DRS extends the distance between devices (up to 15 km).

NOTE: We recommend the use of shielded twisted pair CAT5e (10/100 Mbps) cables, ideally ConneXium 490NTC000••(U).

Interlink

To support distributed I/O sub-rings in Quantum Ethernet I/O installations, establish an interlink between an Ethernet communication module on the main rack and the 140 CRP 312 00 head module:



1 main rack: This rack includes a 140 NOE 771 00 communication module that is interlinked to a 140 CRP 312 00 head module.
2 DRS: This switch is connected to the main ring and a distributed I/O sub-ring.
3 distributed I/O sub-ring

You can use the 140 NOE 771 •• communication module instead of the 140 NOE 771 00.

NOTE: For the Interlink connection, we recommend the use of shielded twisted pair CAT5e (10/100 Mbps) cables. If you add a second Ethernet communication module (140 NOC 771 •• or 140 NOE 771 ••) to your local rack, you can connect it to a Control network through a CAT6 (10/100/1000 Mbps) cable.

Duplicate IP Address Checking

Introduction

The 140 CRP 312 00 head module on the local rack has 4 ports. The 140 CRA 312 00 adapter module on the remote drop has 3 ports. However, each module has a single IP address. Therefore, the address conflict detection algorithm (also called duplicate IP checking) is performed based on the status (link up, link down) of the ports.

Link Down

These conditions apply when links are lost:

Link Status	Description
A transition has occurred from 1 connected link to all links down.	When no module ports are connected to a cable (all links are down), all services are reset. For example, I/O connections, Modbus connections, and explicit EtherNet/IP connections close, but low-level network services (RSTP, switch, etc.) are not affected. The updated Net Status LED indicates the status.
There is 1 link down and at least 1 connected link.	There is no impact on services that are running in the module.

Link Up

These conditions apply when links are added:

Link Status	Description
A transition has occurred from no connected links to 1 connected link.	A duplicate IP check is performed: ● *no duplicate*: All services start. ● *duplicate*: I/O services stop. The 140 CRA 312 00 gets new configuration and re-downloads the IP configuration. The system goes to default IP and I/O modules are set to fallback mode.
A transition has occurred from at least 1 connected link to an additional connected link.	A duplicate IP check is performed: ● no duplicated: All services continue. ● duplicate: All services stop. **NOTE:** The updated Net Status LED indicates the status.

Loss of I/O Connection

Conditions

An I/O connection can be lost under some conditions:

Condition	CPU	140 CRP 312 00	140 CRA 312 00
• Perform a Hot Swap. • Replace a module of the same type.	**X**	**X**	**X**
There is no remote I/O cable connection.		**X**	**X**
The I/O connection is closed.*			**X**
*Hot Swap of the CPU results in an explicit close (lost I/O connection).			

140 CRA 312 00 Fallback

In some instances, the 140 CRA 312 00 adapter module on the remote I/O drop can lose I/O connections for a period longer than the configured hold up time. During the hold up, the 140 CRA 312 00 tries to get IP and configuration parameters from the 140 CRP 312 00. When the 140 CRA 312 00 cannot get those parameters:

- *inputs*: retain last known values
- *outputs*: set to fallback

NOTE: Configure the hold up time on the Unity Pro **Parameter** tab *(see page 60)*.

Configuration and Programming with Unity Pro

3

Introduction

Use Unity Pro to configure your local rack and remote drops for Ethernet communications.

What's in this Chapter?

This chapter contains the following sections:

3.1 Creating a Unity Pro Project

Introduction

Use the instructions in this section to create a Unity Pro project that allows communications between a local rack and an Ethernet remote I/O drop. Here are the basic stages of the Unity Pro configuration:

1 Select an high-end Quantum processor to create a new Unity Pro configuration.
2 Add a power supply to the local rack.
3 Add an Ethernet remote I/O head module (140 CRP 312 00) to the local rack.
4 Configure a rack assembly for the Ethernet remote I/O drop.

NOTE: These instructions assume that you have a working knowledge of Unity Pro.

What's in this Section?

This section contains the following topics:

Configuring the Local Rack

Instructions

Use Unity Pro to install a 140 CRP 312 00 module as the head of a local rack:

Step	Action	Comment
1	In Unity Pro, create a new project.	Path: **File** → **New**. (The **New Project** window appears.)
2	Add a PLC from the **New Project** window.	For this example, double-click the 140 CPU 651 50: **New Project** → **Quantum** → **140 CPU 651 50**. (The **Project Browser** appears.)
3	In the **Project Browser**, double-click **Local Bus**.	Path: **Tools** → **Project Browser** → **Configuration** → **Local Bus**. The **Local Bus** window opens and the rack includes the processor you selected.
4	Add a power supply to the rack.	For this example, drag the 140 CPS 114 •0 to slot 1 in the local rack: **Tools** → **Hardware catalog** → **Local Quantum Drop** → **Supply** → **140 CPS 114 •0**
5	Add a 140 CRP 312 00 module to an available slot in the local rack.	For this example, drag a 140 CRP 312 00 module to slot 4: **Tools** → **Hardware catalog** → **Local Quantum Drop** → **Communication** → **140 CRP 312 00**
6	In the same manner, drag a 140 NOE module to the local rack.	When you connect distributed I/O devices (through dual-ring switches) to the Ethernet remote I/O main ring, insert a 140 NOE communications module on the local rack.
7	Double-click on any empty slot to add modules to the **Local Bus**.	For this example, this step is optional.
8	Save the file.	Path: **File** → **Save**.

As the **Local Bus** window shows, your configuration includes:

- CPU (140 CPU 651 50)
- power supply (140 CPS 114 •0)
- local rack head module (140 CRP 312 00)

NOTE: An Ethernet remote I/O drop (**ERIO Bus**) now appears in the **Project Browser**. Unity Pro automatically added this drop to the configuration when you added the 140 CRP 312 00 module to your local rack because that module is designed to communicate with an Ethernet remote I/O drop.

You can double-click on the 140 CRP 312 00 module in the **Local Bus** window to access these configuration parameters for the local rack:

- IP Config *(see page 52)*
- RSTP *(see page 53)*
- SNMP *(see page 54)*
- Service port *(see page 56)*
- DeviceDDT *(see page 63)*

NOTE: You may either accept the automatically assigned IP address or change the IP address in the Unity Pro **IP Config** tab.

Rack Considerations

Remember:

- You can cut or copy other devices in the local rack or the drop and paste them in any rack of the same type. You can perform these actions (cut, copy, paste) only in the same device editor. You cannot move objects from the local rack to the drop or vice-versa.
- The number of the first slot in a rack is 1. Therefore, a 4-slot rack has slot numbers 1, 2, 3, 4.

Configuring the Ethernet Remote I/O Drop

Instructions

After you add a 140 CRP 312 00 module to your local rack in a Unity Pro project *(see page 47)*, Unity Pro automatically adds an Ethernet remote I/O rack (**ERIO Bus**) to your configuration.

Now you can configure the drop (**ERIO Bus**) to include a rack assembly with a 140 CRA 312 00 adapter in slot 1:

Step	Action	Comment
1	In the **Project Browser**, double-click on **ERIO Bus** to see the (empty) drop.	Path: **Tools** → **Project Browser** → **Structural view** → **Project** → **Configuration** → **ERIO Bus**
2	In the **ERIO Bus** window, double-click on the square link connector to access the available racks.	The **New Device** window appears.
3	In the **New Device** window, double-click any rack to add it to the **ERIO Bus**.	This example uses the 4-slot 140 XBP 004 00 rack: **New Device** → **Part Number** → **ERIO Quantum Drop** → **Rack** → **140 XBP 004 00**. Select the device and press **OK**. The **ERIO Bus** window now includes the rack. Because the Ethernet remote I/O drop requires a module for communications with the local rack, Unity Pro automatically adds a 140 CRP 312 00 module in slot 1.
4	Double-click on any empty slot to add modules to the **ERIO Bus**.	For this example, this step is optional.

As the **ERIO Bus** window shows, a 140 CRA 312 00 module is now installed as the adapter of your Ethernet remote I/O drop. Double-click on this module to see its configuration tabs:

- RSTP *(see page 53)*
- SNMP *(see page 54)*
- Service port *(see page 56)*

Rack Considerations

Remember:

- An Ethernet remote I/O drop contains a maximum of 2 racks.
- You can cut or copy other devices in the remote drop and paste them in any rack of the same type. You can perform these actions (cut, copy, paste) only in the same device editor. You cannot move objects from the local rack to the drop or vice-versa.
- The number of the first slot in a rack is 1. Therefore, a 4-slot rack includes slot numbers 1, 2, 3, 4.

Available Unity Pro Configuration Tabs

About the Parameters

The Unity Pro configuration tabs are available after you have configured:

- the local rack (including a 140 CRP 312 00 head module) *(see page 47)*
- the Ethernet remote I/O drop (including a 140 CRA 312 00 adapter module) *(see page 49)*

Unity Pro Configuration Tabs

This table indicates the available Unity Pro configuration tabs for the 140 CRP 312 00 and 140 CRA 312 00 modules:

Unity Pro Tab	**140 CRP 312 00 (local rack)**	**140 CRA 312 00 (remote I/O drop)**
IP Config *(see page 52)*	**X**	(See note.)
RSTP *(see page 53)*	**X**	**X**
SNMP *(see page 54)*	**X**	**X**
Service port *(see page 56)*	**X**	**X**
Device DDT *(see page 64)*	**X**	
NOTE: The 140 CRA 312 00 module automatically receives an IP address. To maintain unique addressing on the network, keeping and using the auto-assigned IP addresses is generally considered a good practice.		

3.2 Unity Pro Configuration for Remote I/O Ethernet Modules

Overview

This section describes the module configuration tabs in Unity Pro. Use the parameters on these tabs to configure services for the 140 CRP 312 00 module in the local rack and the 140 CRA 312 00 module in Ethernet remote I/O drops.

What's in this Section?

This section contains the following topics:

IP Configuration

Access the IP Config Tab

The Unity Pro IP configuration parameters apply to the 140 CRP 312 00 head module in the local rack. To access the **IPConfig** tab, double-click on the 140 CRP 312 00 module *(see page 47)*.

IP Config Parameters

Configure the IP parameters for the 140 CRP 312 00 head module in the **IP address configuration** field on the **IP Config** tab:

Parameter	Description	Default Value
IP address A	The address corresponds to the 140 CRP 312 00 module.	192.168.10.1
IP address B	This address is used for Hot Standby configurations. **NOTE:** If you change IP address A, the system may recalculate all IP addresses (including those of the drops) to keep all devices in the same subnet.	IP address A + 1
Subnetwork mask	This bit mask identifies or determines the IP address bits that correspond to the network address and the subnet portion of the address. (The value can be changed to any valid value in the subnetwork.)	255.255.252.0
Gateway address	This is the IP address of the default gateway to which messages for other networks are transmitted.	0.0.0.0 (when not used)

Configure the IP parameters for the 140 CRA 312 00 module (in the remote drop) in the **CRA IP address configuration** field on the **IP Config** tab:

Parameter	Description	Default Value
Drop No.	drop number	—
Device Name	device name (140 CRA 312 00 adapter)	—
IP Address	When an Ethernet remote I/O drop is added, the 140 CRA 312 00 module is automatically assigned an IP address. (You can change this IP address in the **IP Address** column, but we recommend that you accept the automatically assigned IP address.)	—

RSTP Bridge Configuration

About RSTP

Use RSTP to design a network with redundant cabling so that remote I/O communications automatically find an alternate path if a communication disruption occurs (for example, a cable breaks or a device becomes inoperable). This method does not require you to manually enable or disable communication paths.

Changing these parameters can affect sub-ring diagnostics, I/O determinism, and network recovery times.

Access the RSTP Tab

You can access the **RSTP** parameters in Unity Pro by double-clicking these modules in the Unity Pro rack view:

- 140 CRP 312 00
- 140 CRA 312 00

Parameters

This table shows the **Bridge priority** parameters for the **RSTP Operational State** on the Unity Pro **RSTP** tab

Bridge Priority	Value	140 CRP 312 00	140 CRA 312 00
Root	0	default	—
Backup Root	4096	for Hot Standby (automatic)	—
Participant	32768	—	default
NOTE: In Hot Standby systems, the RSTP bridge priority is applied to the 140 CRP 312 00 module in rack A.			

SNMP Agent Configuration

About SNMP

Use the **SNMP** tab in Unity Pro to configure SNMP parameters for Quantum Ethernet I/O modules (140 CRP 312 00 and 140 CRA 312 00).

An SNMP v1 agent is a software component of the SNMP service that runs on these modules to allow access to the modules' diagnostic and management information. You can use SNMP browsers, network management software, and other tools to access this data. In addition, the SNMP agent can be configured with the IP addresses of 1 or 2 devices (typically PCs that run network management software) to be the targets of event-driven trap messages. Such messages inform the management device of events like cold starts and the inability of the software to authenticate a device.

Access the SNMP Tab

You can access the Unity Pro **SNMP** tab by double-clicking on these modules in the Unity Pro configuration:

- 140 CRP 312 00
- 140 CRA 312 00

Use the **SNMP** tab to configure the SNMP agents for the communication modules in the local rack and remote drop. The SNMP agent can connect to and communicate with 1 or 2 SNMP managers as part of an SNMP service. The SNMP service includes:

- authentication checking, by the Ethernet communication module, of any SNMP manager that sends SNMP requests
- management of events or traps

SNMP Parameters

These parameters are found on the Unity Pro **SNMP** tab:

Field	Parameter	Description	Value
IP Address managers	IP Address manager 1	The address of the first SNMP manager to which the SNMP agent sends notices of traps.	0.0.0.0 ... 255.255.255.255
	IP Address manager 2	The address of the second SNMP manager to which the SNMP agent sends notices of traps.	

Field	Parameter	Description	Value
Agent	Location (SysLocation)	device location	31 characters (maximum)
	Contact (SysContact)	description of the person to contact for device maintenance	
	Enable SNMP manager	unchecked (default): You can edit the **Location** and **Contact** parameters. checked: You cannot edit the **Location** and **Contact** parameters.	checked/unchecked
Community names	Set	password that the SNMP agent requires to read commands from an SNMP manager (default = **Public**)	15 characters (maximum)
	Get		
	Trap		
Security	Enable “Authentication failure” trap	unchecked (default): not enabled. checked (enabled): The SNMP agent sends a trap notice to the SNMP manager if an unauthorized manager sends a **Get** or **Set** command to the agent.	checked/unchecked
On line behavior	—	—	—

Tests are done to verify that the IP addresses of the managers are not:

- multicast
- loopback
- broadcast

Service Port Configuration

Access the Service Port Tab

You can access the Unity Pro **Service Port** tab by double-clicking on these modules in the Unity Pro rack view:

- 140 CRP 312 00 head module
- 140 CRA 312 00 drop module

Service Port Parameters

These parameters are on the Unity Pro **Service Port** tab:

Field	Parameter	Value	Comment
Service Port	**Enabled**	—	Enable port and edit port parameters.
	Disabled	—	Disable port parameters.
Service Port Mode	**Access** (default)	—	This mode supports Ethernet communications.
	Mirroring	—	In port mirroring mode, data traffic from one or more of the other ports is copied to this port. A connected tool can monitor and analyze port traffic. **NOTE:** In this mode, the SERVICE port acts like a read-only port. That is, you cannot access devices (ping, connection to Unity Pro, etc.) through the SERVICE port.
Access Port Configuration	**Service Port Number**	ETH1	You cannot edit the value in the **Service Port Number** field.
Port Mirroring Configuration	**Source Port(s)**	**Internal Port**	all Ethernet traffic for the module
		ETH2	**140 CRP 312 00:** all INTERLINK port traffic
			140 CRA 312 00: Ethernet traffic through the first remote I/O port
		ETH3	**140 CRP 312 00:** Ethernet traffic through the first remote I/O port
			140 CRA 312 00: Ethernet traffic through the second remote I/O port
		ETH4	Ethernet traffic through the second remote I/O port (140 CRP 312 00 only)

On Line Behavior

The **Service Port** parameters are stored in the application, but you can reconfigure (change) the parameters in connected mode. Values that you reconfigure in connected mode are sent to the 140 CRA 312 00 adapter or 140 CRP 312 00 head module in explicit messages. (The changed values are not stored, so a mismatch can exist between the parameters that are being used and those in the stored application.) If the module does not respond to the explicit messages, a message appears.

Limitations

The SERVICE port on the 140 CRP 312 00 and 140 CRA 312 00 modules have the same limitations as the cloud port of the dual-ring switch (DRS). Therefore, the module's cloud port and the DRS's cloud port can be connected to the same equipment.

The maximum load the module can process from distributed I/O devices:

- 5 Mbps: per SERVICE port
- 20 Mbps: total distributed I/O traffic on the main ring

For more information about considerations that apply to the use of the distributed I/O cloud port and the service port on the DRS, refer to "Predefined Configuration Files" in the PlantStruxure Quantum Ethernet I/O System Planning Guide.

3.3 Unity Pro Configuration for Ethernet Remote I/O Drops

Introduction

This section discusses the use of Unity Pro to configure the Ethernet remote I/O drop and its 140 CRA 312 00 adapter module. It includes descriptions of the parameters on the **Configuration**, **Parameter**, and **Device DDT** tabs in Unity Pro.

NOTE: These instructions assume that you have already added a remote I/O drop to your Unity Pro project *(see page 37)*.

What's in this Section?

This section contains the following topics:

Configuring the Size and Location of Data

Introduction

Use the Unity Pro **Configuration** tab to configure the size and location of data for an Ethernet remote I/O drop that includes a 140 CRA 312 00 module.

NOTE: These instructions assume that you have already added a drop to your Unity Pro project *(see page 49)*.

Access the Configuration Tab

Access the **Configuration** parameters in Unity Pro:

Step	Action	Comment
1	Expand (+) **ERIO Bus** in the Unity Pro **Project Browser**.	Path: **Project Browser** → **ERIO Bus** → **ERIO Quantum Drop**
2	Double-click on **ERIO Quantum Drop**.	The **Quantum Drop for ERIO** window appears. It contains the parameter tabs from the remote I/O drop.
3	Select the **Configuration** tab.	

Configuration Parameters

On the Unity Pro **Configuration** tab, configure these parameters for the Ethernet remote I/O drop:

Parameter Name	Value
Starting address status table	the first register in the status table (configured)
Ending address status table	the starting address + the maximum number of addresses for the configured rack size
In Bytes	the total number of bytes for input modules in the remote I/O drop
Out Bytes	the total number of bytes for output modules in the remote I/O drop

Configuring the Parameters

Parameter Tab (Remote I/O Drop)

This topic describes the Unity Pro **Parameter** tab for an Ethernet remote I/O drop that includes a 140 CRA 312 00 module.

NOTE: These instructions assume that you have already added a drop to your Unity Pro project *(see page 49)*.

Access the Parameter Tab

Access the **Parameter** tab in Unity Pro:

Step	Action	Comment
1	Expand (+) **ERIO Bus** in the Unity Pro **Project Browser**.	Path: **Project Browser** → **ERIO Bus** → **ERIO Quantum Drop**
2	Double-click on **ERIO Quantum Drop**.	The **Quantum Drop for ERIO** window appears. It contains the parameter tabs for the remote I/O drop.
3	Select the **Parameter** tab.	

Parameter Descriptions

Use the Unity Pro **Parameter** tab to configure the following parameters for the Ethernet remote I/O drop.

Address Information parameters:

Parameter	Comment
Device Name	The device name of the device includes a fixed device prefix and a number provided by the rotary switch. For example, the device name 140CRA01 includes the device prefix (`140CRA`) and the value (`01`) configured on the rotary switches when **Tens** = 0 and **Ones** = 1. When the device is placed on the Ethernet remote I/O drop, the number is set to the device number. The device number does not change when the device moves to a new location. Valid device numbers are unique within the application. When analysis reveals device numbers that are redundant, this message is displayed: `{ERIO Bus (2) 140 CRA 312 00}: Device name is not unique`
IP Address	You cannot edit the **IP address** and **Sub network** (mask) fields. The IP address is editable only in the **IP Configuration** tab *(see page 52)* of the 140 CRP 312 00 module. The value for **Sub network** is deduced from the 140 CRP 312 00 sub network mask.
Sub Network	

Hold up time parameter:

Parameter	Comment
Hold up time	The hold up time represents the time (ms) that device outputs are maintained in their current states after a communication disruption and before taking their fallback values: ● **default value**: 1 sec ● **valid value range**: 50...65,530 ms

The minimum holdup time differs for standalone and hot standby systems. If you assign a holdup time value that is less than the recommended minimum value, you can send an I/O module to the fallback state. When communications are restored, the I/O module restarts and may not operate as intended.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

Do not configure a holdup time value that is less than the recommended minimum value for standalone or hot standby systems:

- standalone systems:
  - periodic application: 4.4 x PLC scan time
  - cyclic application: configured watchdog value
- hot standby systems: configured watchdog value + PLC scan time

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Connection parameters:

Parameter	Comment
Custom RPI	Check this box to configure the **CRA->CRP RPI** value. **NOTE:** The minimum **CRA->CRP RPI** value is 5 ms. **NOTE:** Only change the **CRA->CRP RPI** value if you are using the IU_ERIO function block.
CRA->CRP RPI	**Inputs:** The RPI is the input refresh rate at which the 140 CRA 312 00 sends inputs to the 140 CRP 312 00 module. The RPI is set in the subscribe field for the 140 CRA 312 00 adapter on the remote I/O drop. ● *periodic mode*: default value = 1/2 MAST period. ● *cyclic mode*: default value = 1/4 MAST period. ● *valid values*: 2...1500 (ms) You can configure this value when **Custom RPI** is checked.

Parameter	Comment
CRP->CRA RPI	**Outputs:** Outputs are passed from the 140 CRP 312 00 module to the 140 CRA 312 00 adapter. Set the output refresh rate with the **Application Trigger** value (**CRP->CRA RPI**) at the end of the CPU's MAST task: • *periodic mode*: default value = 1.1 * watchdog timeout period. The value output is sent at the end of the actual MAST period. • *cyclic mode*: default value = 1.1 * (1/4 * watchdog timeout period). The value output is sent at the end of the actual MAST period. **NOTE:** The default value for the Watch dog timer is 250 ms. If the MAST task does not finish within the Watch dog period, the process times out. If the watchdog is greater than 4 times the MAST period, the drops could switch to fallback while the CPU is running. For example, MAST period = 20 ms, logic execution = 90 ms, watch dog time = 100 ms. You can not edit this value. All outputs are published synchronously or at the execution of the MAST task: • synchronously: immediately at the end of the MAST task • execution of IU_ERIO: You can only generate outputs when you use the IU_ERIO function block. (See the note below.)

NOTE:

- When the **Periodic** mode is selected for the MAST task, the **Period** value allows the complete execution of the logic. (The MAST can overrun when its execution time exceeds this value.) Valid values: 1...255 ms (increment: 1 ms).
- When **Cyclic** mode is selected for the MAST task, the outputs are sent upon the completion of the task. The **Watch Dog** value (10 ... 1500 ms, default = 250) should be greater than the execution time. Valid values: 10...1500 ms (increment: 10 ms, default = 250 ms).

On-Line Behavior

In connected mode, only the **Connection** parameters are enabled. Other parameters (**Address information**, **Hold up time**) are disabled.

Device DDT Parameters

Device DDT Parameters (Remote I/O Drop)

This topic describes the Unity Pro **Device DDT** tab for an Ethernet remote I/O drop that includes a 140 CRA 312 00 module. A derived data type (DDT) is a set of elements with the same type (ARRAY) or with different types (structure).

NOTE:

- These instructions assume that you have already added a drop to your Unity Pro project *(see page 49)*.
- Refer to the Derived Data Types chapter *(see page 64)* to create, update, and view derived data types.

Access the Device DDT Tab

Access the **Device DDT** parameters in Unity Pro:

Step	Action	Comment
1	Expand (+) **ERIO Bus** in the Unity Pro **Project Browser**	Path: **Project Browser** → **ERIO Bus** → **ERIO Quantum Drop**
2	Double-click on **ERIO Quantum Drop**.	The **Quantum Drop for ERIO** window appears. It contains the parameter tabs for the remote I/O drop.

The **Implicit device DDT** field contains a default name and type.

Parameters

Use the Unity Pro **Device DDT** tab to configure these parameters for the 140 CRA 312 00 adapter on the remote I/O rack:

Parameter		Description
Implicit device DDT	Name	The default name of the device DDT includes the module type, the number of channels, and a suffix that indicates the insertion number. The explicit instance is indicated by the EXP suffix. For example, MOD_TOR_16_128.
	Type	module type (uneditable)
Goto details		link to the DDT data editor screen

3.4 Derived Data Types

Overview

This chapter describes how to complete your Unity Pro project by creating, updating, and viewing derived data type (DDT) variables.

What's in this Section?

This section contains the following topics:

Device DDT Names (140 CRP 312 00 Head Module)

Introduction

This topic describes the Pro **Device DDT** tab for a local Quantum rack that includes a 140 CRP 312 00 head module. A derived data type (DDT) is a set of elements with the same type (ARRAY) or with different types (structure).

The default device DDT name is composed with the static prefix MOC_COM followed by a number. Example: MOD_COM_1_1).

Access the Device DDT Tab

In Unity Pro:

Step	Action	Comment
1	Expand **Local Bus** in the Unity Pro **Project Browser**.	Path: **Tools** → **Project Browser** → **Project** → **Configuration** → **Local Bus**
2	Double-click the head module (140 CRP 312 00).	The parameter tabs appear.
3	Select the **Device DDT** tab.	

The **Implicit device DDT** field contains a default name and type.

Parameters

Use the Unity Pro **Device DDT** tab to configure parameters for the 140 CRP 312 00 head module on the local rack:

Parameter		Description
Implicit device DDT	Name	The default name of the device DDT includes the module type, the number of channels, and a suffix that indicates the insertion number. The explicit instance is indicated by the EXP suffix. For example, MOD_TOR_16_128.
	Type	module type (uneditable)
Goto details		link to the DDT data editor screen

Implicit Device DDT Types

The 140 CRP 312 00 module implements the implicit device DDT type in accordance with the CPU configuration:

- **T_U_CRP_HSBY_IN:** Hot Standby configurations
- **T_U_CRP_STD_IN:** standalone configurations

Hot Standby Configurations

This table describes the fields in the T_U_CRP_HSBY_IN implicit device DDT type that is used with the 140 CRP 312 00 module in Hot Standby configurations:

Field	Type	Access	Description
LOCAL_PLC	T_U_CRP_STD_IN	R	140 CRP 312 00 status (local PLC)
REMOTE_PLC	T_U_CRP_STD_IN	R	140 CRP 312 00 status (remote/peer PLC)

Standalone and Hot Standby Configurations

The following tables describes the fields in the T_U_CRP_STD_IN implicit device DDT type that is used with the 140 CRP 312 00 module in standalone and hot standby configurations.

ETH_STATUS (BYTE):

Name	Type	Rank	Bit	Description
PORT1_LINK	BOOL	0	0	0 = Port 1 link is down.
				1 = Port 1 link is up.
PORT2_LINK	BOOL	1	1	0 = Port 2 link is down.
				1 = Port 2 link is up.
PORT3_LINK	BOOL	2	2	0 = Port 3 link is down.
				1 = Port 3 link is up.
PORT4_LINK	BOOL	3	3	0 = Port 4 link is down.
				1 = Port 4 link is up.
CRP_LINK	BOOL	4	4	0 = CRP link is down.
				1 = CRP link is up.
REDUNDANCY_STATUS	BOOL	5	5	0 = Redundant owner is not present.
				1 = Redundant owner is present.
	NOTE: In Hot Standby systems, if this bit is set to 1 either in the local or remote 140 CRP 312 00 DDT then the main physical ring is OK. If this bit is set to 0 in both the local and remote 140 CRP 312 00 DDTs, the main physical ring is broken.			
SCANNER_OK	BOOL	6	6	0 = Scanner is not present.
				1 = Scanner is present.
GLOBAL_STATUS	BOOL	7	7	0 = At least 1 service is not operating normally.
				1 = All services are operating normally.

NOTE: You can monitor breaks in the remote I/O main ring by diagnosing the REDUNDANCY_STATUS bits in the 140 CRP 312 00 module DDT. The system detects and reports in this bit a main ring cable break that persists for at least 5 seconds.

Within the REDUNDANCY_STATUS bit:
- 0: The cable is broken or the device is stopped.
- 1: The loop is present and healthy.

In a Hot Standby system, perform a BITWISE OR operation of the REDUNDANCY_STATUS bit in the DDTs for both the primary and standby 140 CRP 312 00 modules to determine whether a cable break has occurred. As indicated above, a value of 0 indicates a cable break; a value of 1 indicates no cable break.

SERVICE_STATUS (BYTE):

Name	Type	Rank	Bit	Description
RSTP_SERVICE	BOOL	0	0	0 = RSTP service is not operating normally.
				1 = RSTP service is operating normally or disabled.
PORT502_SERVICE	BOOL	2	2	0 = Port 502 service is not operating normally.
				1 = Port 502 service is operating normally or disabled.
SNMP_SERVICE	BOOL	3	3	0 = SNMP service is not operating normally.
				1 = SNMP service is operating normally or disabled.
IP_ADDRESS_STATUS	BOOL	4	4	0 = IP address is a duplicate or unassigned.
				1 = Assigned IP address is not a duplicate.
(reserved bits)	—	5...7	5...7	—

ETH_PORT_STATUS:

Name	Rank	Bit	Description
These combined 2-bit values indicate the conditions (WORD)	—	1/0	Ethernet port 1 function
	—	3/2	Ethernet port 1 RSTP role
	—	5/4	Ethernet port 2 function
	—	7/6	Ethernet port 2 RSTP role
	—	9/8	Ethernet port 3 function
	—	11/10	Ethernet port 3 RSTP role
	—	12/13	Ethernet port 4 function
	—	14/15	Ethernet port 4 RSTP role

Name	Rank	Bit	Description
port function	—	0	disabled
		1	access port
		2	port mirror
		3	remote I/O network port
RSTP role	—	0	alternate
		1	backup
		2	designated
		3	root

IN_BYTES:

Type	Rank	Bit	Description
UINT	4/5	—	number of bytes (octets) received on interface

IN_ERRORS:

Type	Rank	Bit	Description
UINT	6/7	—	number of inbound packets that contain errors (In Errors)

OUT_BYTES:

Type	Rank	Bit	Description
UINT	8/9	—	number of bytes (octets) sent on interface

OUT_ERRORS:

Type	Rank	Bit	Description
UINT	10/11	—	number of outbound packets that contain errors (In Errors)

Device DDT Names (140 CRA 312 00 Drop Module)

Introduction

This topic describes the Unity Pro **Device DDT** tab for an Ethernet remote I/O drop that includes a 140 CRA 312 00 adapter module.

The I/O structure type for the Quantum Ethernet I/O drop is: T_U_DROP_STD_IN. The default DDT name is in this format: `DROP_#`. (The **#** symbol represents the drop number. That is, the second drop has the default DDT name `DROP_2`).

NOTE: These instructions assume that you have already added a drop to your Unity Pro project *(see page 37)*.

Access the Device DDT Tab

In Unity Pro:

Step	Action	Comment
1	Expand **ERIO Bus** in the Unity Pro **Project Browser** to display the **ERIO Quantum Drop** icon.	Path: **Tools** → **Project Browser** → **Project** → **Configuration** → **ERIO Bus** → **ERIO Quantum Drop**
2	Double-click the **ERIO Quantum Drop** icon.	The **Quantum Drop for ERIO** window appears.
3	Select the **Device DDT** tab.	

The **Implicit device DDT** field contains a default name and type.

Parameters

Use the Unity Pro **Device DDT** tab to configure these parameters for the Ethernet remote I/O drop:

Parameter		Description
Implicit device DDT	Name	The default name of the device DDT includes the module type, the number of channels, and a suffix that indicates the insertion number. The explicit instance is indicated by the EXP suffix. For example, MOD_TOR_16_128.
	Type	module type (uneditable)
Goto details		link to the DDT data editor screen

Parameters

This table contains the DROP diagnostic parameters for the 140 CRA 312 00 remote I/O drop module:

Name	Type	Rank	Bit	Description
DEVICE_NAME	string[16]	—	—	device name of the remote I/O drop *(see page 60)*
VERSION	WORD	—	—	firmware version (Maj, Min) (4 digits coded in BCD)
ROTARY_SWITCHES	BYTE	—	—	rotary switch value at power up
CRA_STATE	BYTE	—	—	1: CRA module is idle.
				2: CRA module is stopped.
				3: CRA module is running.
CRA_DIAGNOSTIC	WORD	—	—	CRA diagnostic information
GLOBAL_IO_HEALTH	BOOL	—	—	0: At least one I/O module in the drop reports bad health.
CCOTF_IN_PROGRESS	BOOL	—	1	CCOTF is in progress.
CCOTF_INVALID_CONF	BOOL	—	2	CCOTF configuration is not valid.
IOPL_MISMATCH	BOOL	—	3	There is an output data mismatch.
SWITCH_CHANGE	BOOL	—	4	The rotary switches settings have changed since the last power up.
DROP_COM_HEALTH	BOOL	—	5	drop communication health (set to 1 in remote I/O drop)
CYCLE_CURR_TIME	UINT	—	—	word that indicates the execution time of the last CRA cycle (0…655 ms with 10 ms resolution)
CYCLE_MAX_TIME	UINT	—	—	word that indicates the longest CRA cycle execution time (0…655 ms with 10 ms resolution) since the last start
CYCLE_MIN_TIME	UINT	—	—	word that indicates the shortest CRA cycle execution time (0…655 ms with 10 ms resolution) since the last start
TIME_STAMP_RECORDS (reserved)	UINT	—	—	—

Name		Type	Rank	Bit	Description
ETH_STATUS (BYTE)	PORT1_LINK	BOOL	0	0	0 = Port 1 link is down.
					1 = Port 1 link is up.
	PORT2_LINK	BOOL	1	1	0 = Port 2 link is down.
					1 = Port 2 link is up.
	PORT3_LINK	BOOL	2	2	0 = Port 3 link is down.
					1 = Port 3 link is up.
	(reserved bit)	—	3	3	—
	RPI_CHANGE	BOOL	4	4	RPI change: EtherNet/IP RPI change is in progress (during CCOTF).
	REDUNDANCY_OWNER	BOOL	6	6	0 = Redundant owner is not present.
					1 = Redundant owner is present.
	GLOBAL_STATUS	BOOL	7	7	0 = At least 1 service is not operating normally.
					1 = All services are operating normally.
SERVICE_STATUS (BYTE)	RSTP_SERVICE	BOOL	0	0	0 = RSTP service is not operating normally.
					1 = RSTP service is operating normally or disabled.
	SNTP_SERVICE (reserved)	BOOL	1	1	0 = SNTP service is not operating normally.
					1 = SNTP service is operating normally or disabled.
	PORT502_SERVICE	BOOL	2	2	0 = Port 502 service is not operating normally.
					1 = Port 502 service is operating normally or disabled.
	SNMP_SERVICE	BOOL	3	3	0 = SNMP service is not operating normally.
					1 = SNMP service is operating normally or disabled.
	(reserved bits)	—	4...7	4...7	—

Name		Type	Rank	Bit	Description
ETH_PORT_STATUS	These combined 2-bit values indicate the conditions	WORD	—	1/0	Ethernet port 1 function
			—	3/2	Ethernet port 1 RSTP role
			—	5/4	Ethernet port 2 function
			—	7/6	Ethernet port 2 RSTP role
			—	9/8	Ethernet port 3 function
			—	11/10	Ethernet port 3 RSTP role
			—	12/13	Ethernet port 4 function
			—	14/15	Ethernet port 4 RSTP role
	port function	—	—	0	disabled
			—	1	access port
			—	2	port mirror
			—	3	remote I/O network port
	RSTP role	—	—	0	alternate
			—	1	backup
			—	2	designated
			—	3	root
NTP_UPDATE (reserved)		UINT	0/1	—	elapsed time (100 ms) since last update from NTP server (reserved)
MAX_PACKET_INTERVAL		UINT	2/3	—	maximum packet interval (ms) for output packets
IN_BYTES		UINT	4/5	—	number of bytes (octets) received on interface
IN_ERRORS		UINT	6/7	—	number of inbound packets that contain errors (In Errors)
OUT_BYTES		UINT	8/9	—	number of bytes (octets) sent on interface
OUT_ERRORS		UINT	10/11	—	number of outbound packets that contain errors (In Errors)

3.5 Application Download

Downloading the Application to the PLC

Downloading the Application to the PLC

Download the Unity Pro application to the PLC through one of its ports or through a connection to an Ethernet communication module, as described below:

Method	Connection
USB port	If the PLC and the PC that is running Unity Pro both have USB ports, you can download the application to the PLC directly through the USB ports.
Modbus Plus port	If the PLC and the PC that is running Unity Pro both have Modbus Plus ports, you can download the application to the PLC directly through the Modbus Plus ports.
serial port	If the PLC and the PC that is running Unity Pro both have serial ports, you can download the application to the PLC directly through the serial ports.
Ethernet port	If the PLC and the PC that is running Unity Pro both have Ethernet ports, you can download the application to the PLC directly through the Ethernet ports.
communication module	You can download the application to the PLC by connecting Unity Pro to the IP address of the communication module.
NOTE: You cannot download the application to the PLC with the 140 CRP 312 00 module.	

Explicit Messaging

4

Overview

EtherNet/IP uses the TCP/IP and UDP/IP protocols to implement both explicit and implicit messaging.

This chapter explains the 140 CRP 312 00 module and its use of explicit messaging for request-and-reply communications for non-real-time information (like configuration and diagnostic data). A network node that receives a TCP/IP-encapsulated explicit message processes the message and generates a response.

NOTE:

- A single Unity Pro application can contain more than 16 explicit messaging blocks, but only 16 explicit messaging blocks can be active at the same time.
- The 140 CRP 312 00 module can process 2 MBP_MSTR blocks per MAST cycle. Therefore, it will take at least 8 MAST cycles to process all requests in 16 MBP_MSTR blocks.

This chapter describes how to use both Unity Pro function block logic and the Unity Pro interface to send explicit messages.

What's in this Chapter?

This chapter contains the following sections:

4.1 EtherNet/IP Explicit Messaging Using MBP_MSTR

Introduction

This section shows you how to configure the `MBP_MSTR` function block for explicit messages.

NOTE: Use the 140 CRP 312 00 module to send MBP_MSTR commands to diagnose the status of sub-rings. For other operations (get remote statistics, read data, etc.), we recommend that you send an MBP_MSTR command from a 140 NO• 771 •• module.

What's in this Section?

This section contains the following topics:

Supported MBP_MSTR Function Codes

Function Codes

We recommend using these MBP_MSTR function codes with the 140 CRP 312 00 module to diagnose sub-rings:

MBP_MSTR Control Code	Description	140 CRP 312 00 Support
0x00 0x0E	EIP explicit message (connected)	X *(see page 78)*
0x01 0x0E	EIP explicit message (unconnected)	X

NOTE: The 140 CRP 312 00 module supports **only** two MBP_MSTR codes per CPU cycle.

EtherNet/IP Explicit Messaging Services

Overview

Communication protocols:

- *EtherNet/IP*: The 140 CRP 312 00 module uses the EtherNet/IP protocol for all exchanges of I/O data.
- *Modbus*: The 140 CRP 312 00 module uses the Modbus/TCP protocol for reading diagnostics and for MBP_MSTR (2 per MAST cycle).

Every EtherNet/IP explicit message performs a service. Each service is associated with a service code (or number). You will need to identify the explicit messaging service by its name, decimal number, or hexadecimal number.

You can execute EtherNet/IP explicit messages using either a Unity Pro `MBP_MSTR` function block or the Unity Pro Ethernet Configuration Tool's **EtherNet/IP Explicit Message Window**.

NOTE: Configuration edits made to an Ethernet communication module from the Unity Pro Ethernet Configuration Tool's EtherNet/IP Explicit Message Window are not saved to the operating parameters stored in the CPU and, therefore, are not sent by the CPU to the module on startup.

You can use Unity Pro to construct a request that executes any service supported by the target device that is compliant with the EtherNet/IP protocol.

Services

The services supported by Unity Pro include these standard explicit messaging services:

Service Code		Description	Available in...	
Hex	**Dec**		**MBP_MSTR block**	**Unity Pro GUI**
1	1	Get_Attributes_All	X	X
2	2	Set_Attributes_All	X	X
3	3	Get_Attribute_List	X	—
4	4	Set_Attribute_List	X	—
5	5	Reset	X	X
6	6	Start	X	X
7	7	Stop	X	X
8	8	Create	X	X
9	9	Delete	X	X
A	10	Multiple_Service_Packet	X	—
x (available service) — (service not available)				

Service Code		Description	Available in...	
Hex	**Dec**		**MBP_MSTR block**	**Unity Pro GUI**
D	13	Apply_Attributes	X	X
E	14	Get_Attribute_Single	X	X
10	16	Set_Attribute_Single	X	X
11	17	Find_Next_Object_Instance	X	X
14	20	Error Response (DeviceNet only)	—	—
15	21	Restore	X	X
16	22	Save	X	X
17	23	No Operation (NOP)	X	X
18	24	Get_Member	X	X
19	25	Set_Member	X	X
1A	26	Insert_Member	X	X
1B	27	Remove_Member	X	X
1C	28	GroupSync	X	—
x (available service) — (service not available)				

Configuring the CONTROL and DATABUF Parameters

Overview

The operations of the MBP_MSTR function block are defined by the CONTROL and DATABUF output parameters. For the EtherNet/IP protocol, the structure of the CONTROL and DATABUF output parameters remains the same for all explicit messaging services.

Configuring the Control Parameter

Use MSRT operation 15 to send generic Modbus requests on the network. (This operation code is not available on the Modbus Plus port or embedded Ethernet port on the CPU.)

The `CONTROL` parameter register contains these consecutive words:

Register	Function	Description
`CONTROL[0]`	operation	15 = send Modbus request operation
`CONTROL[1]`	error status	Holds the event code (read-only).
`CONTROL[2]`	data buffer length	Data buffer length, in words
`CONTROL[3]`	response offset	Offset for the beginning of the response in the data buffer, in 16-bit words **Note:** To avoid overwriting the request, make the response offset value greater than the request length `CONTROL[10]`.
`CONTROL[4]`	routing register	Specify a network destination node during data transfer: • *MSB:* The most significant byte contains the source node address (for example, the slot number of the 140 NOE 771 •• or 140 CRP 312 00 module). **Exception:** The value of the integrated Ethernet port on the CPU is 254 (FE h) regardless of the CPU slot number. **Note:** Only 1 Ethernet 140 CRP 312 00 module can be used. • *LSB:* The least significant byte contains the destination node address (for example, MBP on the Ethernet Transporter (MET) mapping index for the 140 NOE 771 •• or the drop number for the 140 CRP 312 00).
`CONTROL[5]`[1]	IP address	Each address contains 1 byte of the 32-bit IP address: • high byte = byte 4 of the IP address (MSB) • low byte = byte 3 of the IP address • high byte = byte 2 of the IP address • low byte = byte 1 of the IP address (LSB)
`CONTROL[6]`[1]		
`CONTROL[7]`	request length	length of the CIP request, in bytes
`CONTROL[8]`	response length	length of the response received, in bytes read only—set after completion

1. For example, the Control parameter handles the IP address 192.168.1.6 in the following order: Byte 4 = 192, Byte 3 = 168, Byte 2 = 1, Byte 1 = 6.

Configuring the Data Buffer

The DATABUF varies in size. It consists of contiguous registers that include—in sequence—both the CIP request and the CIP response. To avoid overwriting the request, the data buffer must be large enough to simultaneously contain both the request and response data.

Data Buffer: Variable size: set in CONTROL[3]	**CIP Request:** Request size: set in CONTROL[10]
	CIP Response: Starting position: set in CONTROL[4] Response size: reported in CONTROL[11] **NOTE:** If the response offset is smaller than the request size, response data overwrites part of the request.

The formats of the data buffer's CIP request and CIP response are described in this table. (Both the request and response must be structured in little endian order.)

Request			
Byte offset	**Field**	**Data Type**	**Description**
0	Service	Byte	Service of the explicit message
1	Request_Path_Size	Byte	The number of words in the Request_Path field
2	Request_Path	Padded EPATH	This byte array describes the path of the request—including class ID, instance ID, etc.—for this transaction
...	Request_Data	Byte array	Service specific data to be delivered in the explicit message request—if none, this field is empty
Response			
Byte offset	**Field**	**Data Type**	**Description**
0	Reply Service	Byte	Service of the explicit message + 16#80
1	Reserved	Byte	0
2	General Status	Byte	EtherNet/IP General Status
3	Size of Additional Status	Byte	Additional Status array size—in words
4	Additional Status	Word array	Additional status
...	Response Data	Byte array	Response data from request, or additional error data if General Status indicates an error

4.2 Explicit Messaging via the Unity Pro GUI

Sending Explicit Messages to EtherNet/IP Devices

Introduction

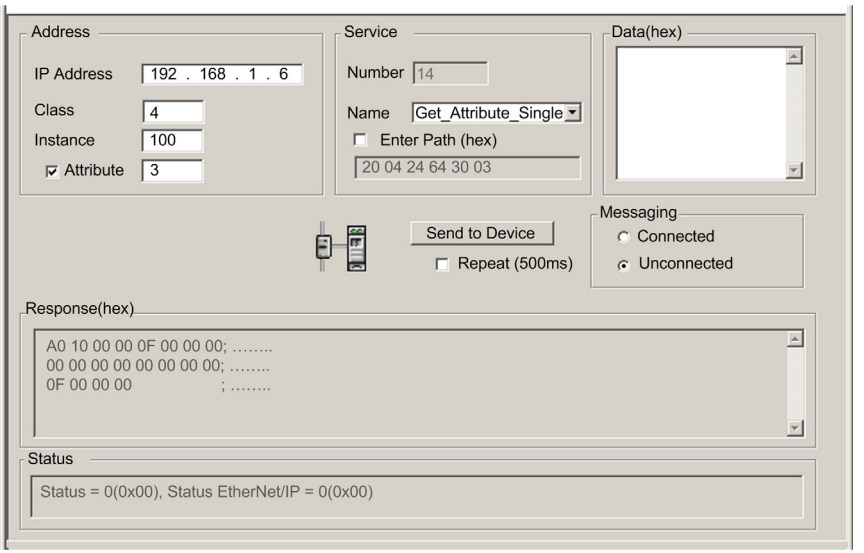
The 140 CRP 312 00 module uses explicit messages from Unity Pro to obtain diagnostics information from an EtherNet/IP module or device on the network.

Access the EtherNet/IP Explicit Message Window

Step	Action	Comment
1	Access the 140 CRP 312 00 module for Online Action.	Refer to the Devices Services tab *(see page 115)*.
2	Double-click the 140 CRP 312 00 module in the Unity Pro rack view.	The **EtherNet/IP Explicit Message** tab appears.

The EtherNet/IP Explicit Message Tab

The **EtherNet/IP Explicit Message** window shows an example of the configuration of an EtherNet/IP explicit message and the response to the message. The explicit message is addressed to a DRS to obtain diagnostic information:



Parameters

Features of the **EtherNet/IP Explicit Message** screen:

Field	Parameter (Value)	Description
Address **NOTE:** Refer to your EtherNet/IP device user manual for the values in the **Address** field.	IP Address (*x.x.x.x*)	The IP address of the target device, used to identify the target of the explicit message. (The IP address in the example above is 192.168.1.6.)
	Class (1...65535)	The class identifier of the target device is an integer that is used to construct the message path. (The class in the example above is 4.)
	Instance (0...65535)	The class instance of the target device is an integer that is used to construct the message path. (The class instance in the above example is 100.)
	Attribute (0...65535)	The specific device attribute (or property) is the target of the explicit message. This integer is used to construct the message path. (The attribute in the above example is 3.) **NOTE:** Check this box to enable this optional field.
Service	Number (1...127)	**Number** is an integer that is associated with the service that the explicit message performs. **NOTE:** If you select **Custom Service**, type in a service number. This field is read-only for all other services.
	Name	Scroll to the name of the service that you want the explicit message to perform. In the example above, **Get_Attribute_Single** is selected.
	Enter Path (hex)	Check this box to enable the message path field where you can manually enter the entire path to the target device. (In the example above, the box is not checked.)
Data (hex)	—	The Data field contains the data to be sent to the target device for services that send data. (The field is blank in the example above.)
Messaging	Connected Unconnected	Select the type of explicit message to send: • *unconnected*: An unconnected message requires path information (addressing) that identifies the destination device and (optionally) device attributes. • *connected*: A connected explicit message contains path information and a connection identifier to the target device. **NOTE:** The example uses an **Unconnected** message.
Send to Device (button)	—	After the explicit message is configured, press **Send to Device**.
Response (hex)	—	**Response** contains the (hexadecimal) data sent to the configuration by the target device when you press **Send to Device**.
Status	—	After you press **Send to Device**, the messages in the **Status** field indicate the status of the explicit message.
Repeat (500ms)	—	Check this box to re-send the explicit message every 500 ms. (In this example, leave this blank.)

NOTE: You can use explicit messaging to perform many different services, but every EtherNet/IP device does not support every service.

4.3 Immediate I/O Access (IU_ERIO)

Description

Function Description

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

Do not use the IU_ERIO function block in Quantum Hot Standby installations.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

An IU_ERIO function block updates Ethernet remote I/O drop input and output modules with an optimal response time. The Ethernet remote I/O drop inputs and outputs are updated during the MAST task.

Call this function block in a MAST task. It can be called more than once in a task.

NOTE: To maintain system performance, we recommend that you use no more than 10 executions of the IU_ERIO block during a single MAST task.

The input and output modules must be physically on an Ethernet remote I/O drop and declared in the Ethernet configuration.

EN and ENO can be configured as additional parameters.

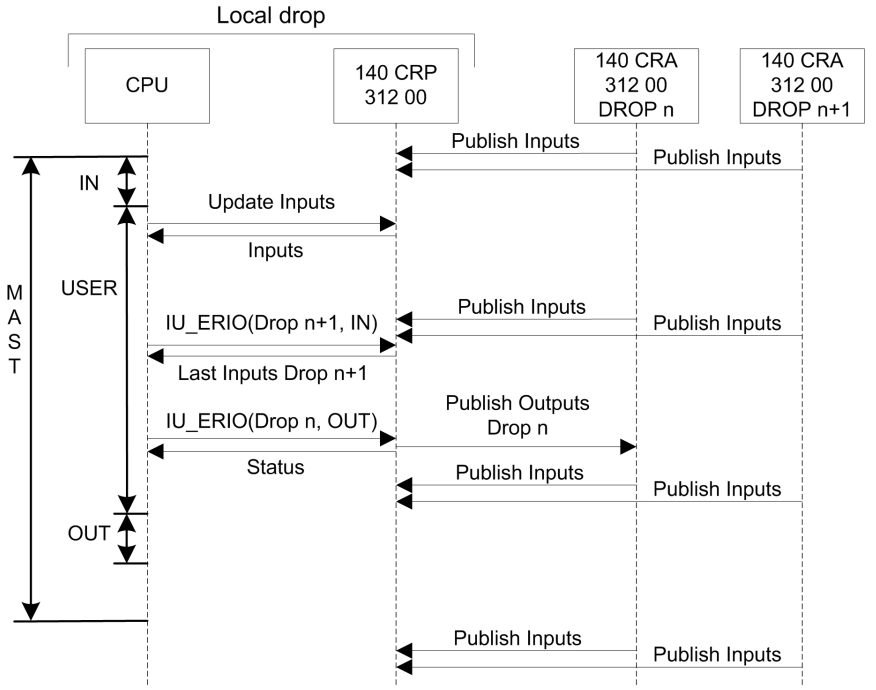
NOTE: Refer to the *Quantum Ethernet I/O System Planning Guide* for calculating the ART when your application does not use an IU_ERIO function block.

IU_ERIO Mechanism

The Ethernet remote I/O drop input values are read in the 140 CRP 312 00 module with an optimal response time.

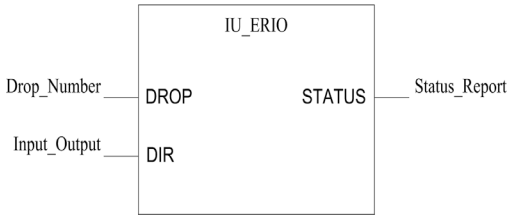
The input values read in the 140 CRP 312 00 module represent the latest values sent in an asynchronous way by the 140 CRA 312 00 adapter of each drop. The maximum time shift between values read in the 140 CRP 312 00 and actual input values depends on the 140 CRA 312 00 publishing frequency (subscribe field **CRA->CRP RPI**) *(see page 60)*.

The following diagram represents the I/O exchanges between a CPU and the Ethernet remote I/O drops:



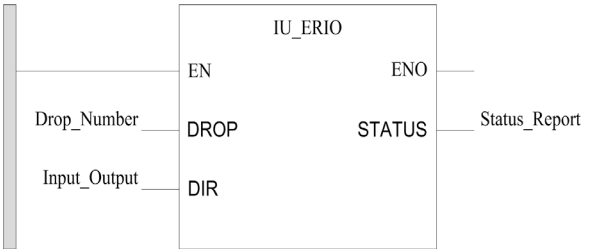
Representation in FBD

Representation:



Representation in LD

Representation:



Representation in IL

```
CAL IU_ERIO(DROP:=>Drop_Number, DIR:=>Input_Output, STATUS=>
Status_Report);
```

Representation in ST

```
IU_ERIO(DROP:=>Drop_Number, DIR:=>Input_Output, STATUS=>Stat
us_Report);
```

Parameter Description

Input parameters:

Parameter	Data type	Meaning
`Drop`	`INT`	Drop number (1...31) Drop number: ● 1: Drop 1 ● 2: Drop 2 ● ... ● 31: Drop 31
`Dir`	`BOOL`	Data direction: ● 0 = Outputs. The output values are sent immediately to the 140 CRP 312 00 module. ● 1 = Inputs. The input values are read immediately from the 140 CRP 312 00 module.

Output parameter:

Parameter	Data type	Meaning
Status	WORD	Status report from the 140 CRP 312 00 module: ● 0002 hex: Invalid drop number ● 0003 hex: Ethernet remote I/O drop is not configured ● 0004 hex: Ethernet remote I/O drop is not connected ● 0006 hex: 140 CRP 312 00 module is not present on the local drop ● 0007 hex: An error is detected on the 140 CRP 312 00 module ● 0008 hex: Operation was not completed before time out ● 0009 hex: Retry number is exceeded ● 000B hex: Operation OK

NOTE: A detected communication error (system words %SW172 to %SW175) is returned if no connection is opened with the Ethernet remote I/O drop.

Implicit Messaging

5

The MAST Task in Implicit Exchanges

Task Management

This topic explains implicit messaging and the relationship between the MAST task configuration and the remote I/O implicit exchanges.

Implicit messaging maintains open connections for real-time communications of a predefined nature between a consumers and producers. Implicit messages contain control data and a connection identifier.

EtherNet/IP uses the TCP/IP and UDP/IP protocols to implement both explicit and implicit messaging.

Access the MAST Configuration

View the **Properties of MAST**:

Step	Action	Comment
1	Go to the **Properties of MAST** dialog box in Unity Pro.	path: **Tools** → **Project Browser** → **Project** → **Program** → **Tasks** → **MAST**
2	Right-click on **Properties**.	
3	Configure the parameters.	

CIP Definitions

Inputs: The MAST period should be two times the RPI of the 140 CRA 312 00 adapter on the remote I/O drop. This provides new input values for every MAST cycle. (For example, an RPI of 25 ms provides data for a MAST period of 50 ms.)

Outputs: The CPU in the local rack of a Quantum Ethernet I/O system produces outputs to Ethernet remote I/O drops and consumes inputs from those drops (based on the producer/consumer model). A consumer (the remote drop) detects the lack of updated data through a time-out. (Possible time-out values are N x RPI, where N = 4, 8, 16, etc.) When a time-out is triggered, the consumer assumes the producer is absent.

Periodic and Cyclic Modes

The effect that periodic and cyclic modes have on implicit messages is explained in the description of the connection parameters *(see page 60)*.

Quantum I/O Management for Implicit I/O Exchanges

The direct state RAM address manages the Quantum I/O data.

Assign the state RAM addresses for each module. (Default values are proposed by Unity Pro in the module configuration windows.) You can also define symbols on the I/O variables allocated in the state RAM.

Diagnostics

6

Overview

This chapter describes the diagnostics for the Ethernet remote I/O modules. For details on diagnostics at the system level, refer to the systems diagnostics topic in the PlantStruxure Quantum Ethernet I/O System Planning Guide.

What's in this Chapter?

This chapter contains the following sections:

6.1 LED Indicators

What's in this Section?

This section contains the following topics:

LED Indicators on the 140 CRP 312 00 Module

Display

These LEDs are on the front of the 140 CRP 312 00 module:

Indications

LED conditions:

Description		Active	Ready	Mod Status		Net Status	
		green	green	green	red	green	red
general	component not operating	—	off	off	on	off	off
	invalid configuration	—	off	off	flash	off	off
	not configured	—	off	flash	off	off	off
	configured	on	blink	on	off	on/flash	off
	no/default port MAC	—	blink 2	off	on	off	off
power-up sequence	blink (.25 sec on; .25 sec off)	1	2	3	4	5	6
IP address	duplicate IP	—	blink 4	—	—	off	on
	waiting for IP	—	blink 5	—	—	off	off
	default IP address assigned	—	blink 6	—	—	flash	off
	configured IP address assigned	—	on	—	—	flash	off
	invalid configuration	—	blink 7	—	—	off	off
I/O data communication	no I/O or CIP connections	on	on	on	off	flash	off
	at least one I/O data connection to a remote I/O drop	on	on	on	off	on	off
	at least one CIP connection	on	on	off	flash	on	off

NOTE: In Hot Standby systems, the Net Status LEDs on the 140 CRP 312 00 modules are solid green during normal operations. Other considerations:

- When power to the 140 CRP 312 00 module in rack B is lost, the Net Status LED on the 140 CRP 312 00 module in rack A starts to blink red.
- When power to the 140 CRP 312 00 module in rack A is lost, the Net Status LED on the 140 CRP 312 00 module in rack B is unchanged (solid green).

Ethernet Port Indications

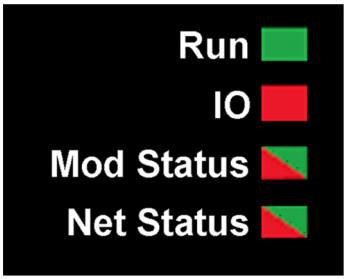
These LEDs report the status of the Ethernet port:

Name	Color	Status	Description
LINK	green	on	100 Mbps link detected
	yellow	on	10 Mbps link detected
	—	off	no detected link
ACT	green	blinking	active Ethernet link (transmit or receive)
	—	off	inactive Ethernet link

LED Indicators on the 140 CRA 312 00 Module

Display

These LEDs are on the front of the 140 CRA 312 00 module:



Indications

LED conditions:

Description		Run	IO	Mod Status		Net Status	
		green	red	green	red	green	red
power-up sequence	blink (.25 sec on; .25 sec off)	1	2	3	4	5	6
not configured	IP address not valid	—	—	flashing	off	off	off
	• valid IP address • invalid configuration	off	off	flashing	off	flashing	off
configured	no external error detected	flashing	off	—	—	flashing	off
	external error detected	flashing	on	—	—	flashing	off
I/O data communication established	STOP	flashing	(note 1)	on	off	on	off
	RUN	on	(note 2)	on	off	on	off
detected error states	recoverable error	—	—	off	flashing	—	—
	nonrecoverable error	flashing	on	off	on	—	—
	duplicate IP address	—	—	—	—	off	on
OS firmware update		flashing	off	off	on	off	on

NOTE 1 (STOP state):
- on: An input or output is a detected error that originates in a module, or a channel configuration or a channel configuration error has been detected.
- off: Operations are normal.

NOTE 2 (RUN state):
- on: External error is detected.
- off: External error is not detected.

Ethernet Port Indications

These LEDs report the status of the Ethernet port:

Name	Color	Status	Description
LINK	green	on	100 Mbps link detected
	yellow	on	10 Mbps link detected
	—	off	no detected link
ACT	green	blinking	active Ethernet link (transmit or receive)
	—	off	inactive Ethernet link

6.2 Service Port Management

What's in this Section?

This section contains the following topics:

Service Port Configuration for 140 CRP 312 00

Introduction

The 140 CRP 312 00 module and 140 CRA 312 00 adapter both support the configuration of the SERVICE port without requiring you to re-build or download your application.

140 CRP 312 00

The online configuration of the SERVICE port on the 140 CRP 312 00 module is discussed in the section about diagnostics through Unity Pro *(see page 117)*.

140 CRA 312 00

You can send explicit messages with an EtherNet/IP tool for the configuration of the SERVICE port on the 140 CRA 312 00 adapter. For details, refer to the discussion of EtherNet/IP CIP objects *(see page 112)*.

Cycling Power

The online configuration of the SERVICE port is volatile. The following situations can arise when power is cycled to the module while the application is being applied:

- The configuration can be lost.
- The configuration in the application can be applied to the SERVICE port.

Service Port Configuration for 140 CRA 312 00

Configuration

Follow these steps to modify the **Service Port** configuration of an online 140 CRA 312 00 module:

Step	Action
1	Launch the EtherNet/IP Explicit Message window *(see page 82)*.

2	Assign these **Device Services** parameters:
	• **Address**:
	  • **IP Address:** Enter the IP address of the 140 CRA 312 00 module with the Service Port you want to configure.
	  • **Class:** 0x400
	  • **Instance:** 1
	• **Service**:
	  • **Name:** Set_Attribute_Single

3	Set the **Port Control** value: • **Attribute**: Check this box. • **Attribute** (field): Enter **1** (access port). • **Data(hex)** (field): Enter a value that is based on the **Port Control** attribute definition *(see page 112)*. **NOTE:** • If you enter **2** (port mirroring) in **Attribute**, refer to the next table. • In port mirroring mode, the SERVICE port acts like a read-only port. That is, you cannot access devices (ping, connection to Unity Pro, etc.) through the SERVICE port.
4	Leave the default values for these parameters: • **Enter Path(hex)**: Do not check this box. • **Repeat(500ms)**: Do not check this box. • **Messaging**: Select **Unconnected**.
5	Press **Send to Device**.

Port Mirroring: Use these steps only if you chose 2 (port mirroring) for the **Port Control** value (above):

Step	Action
1	Set the **Port Control** value: • **Attribute**: Check this box. • **Attribute**: Enter **2** (port mirroring). • **Data(hex)**: Enter a value that is based on the **Port Control** attribute definition *(see page 112)*.
2	Accept the default values for other parameters (as before).
3	Press **Send to Device**.

6.3 Diagnostics Available through the CPU

What's in this Section?

This section contains the following topics:

System Diagnostics

Introduction

System diagnostics are performed locally on the CPU with system bits (%S) and system words (%SW).

Local Rack Diagnostics

Local rack diagnostics are accessible for the 140 CRP 312 00, 140 NOC 771 ••, and 140 NOE 771 •• modules within the standard system bits (%SW180 to %SW339).

Ethernet Remote I/O Drop Diagnostics

Ethernet remote I/O drop diagnostics are accessible for the entire drop within system bits and words in the PLC (%S, %SW). Each drop is animated with a health bit display of the health bit status for:

- a drop node
- a module in a remote drop

The Quantum PLC on the local rack monitors remote I/O drops and module health. The 140 CRA 312 00 module on the remote I/O drop transmits detected errors in drop modules to the Quantum PLC via implicit exchanges *(see page 106)*. The detected errors are stored in the PLC's global diagnostic buffers and in the individual drop module's diagnostic buffer.

The Quantum PLC or the 140 CRP 312 00 module on the local rack updates the detected error buffers. Health bits are updated in the PLC only if the 140 CRA 312 00 of the concerned drop communicates with the 140 CRP 312 00 module on the local rack. If these modules cannot communicate, the concerned health bits are set to 0.

System Bits and Words

This table describes new or modified system bits and words that represent detected errors:

System Bits/Words	Symbol	Description
%S117	ERIOERR	detected remote I/O error on the Ethernet I/O network
%SW101	ERIO_ CCOTF_COUNT	ERIO CCOTF counting status register
%SW108	FORCED_DISCRETE_COUNT	forced bit counting status register
%SW109	FORCED_ANALOG_COUNT	forced bit counting status register
%SW152 ... %SW155	ERIO_DROP_ERROR	detected Ethernet remote I/O drop error status register
%SW172 ... %SW175	ERIO_CONNECT_STATUS	Ethernet I/O communication health status for drops in standalone and primary systems.

System Bits/Words	Symbol	Description
%SW176 ... %SW179	SDBY_ERIO_CONNECT_STATUS	Ethernet I/O communication health status for drops in standby systems.
%SW180 ... %SW181	IOHEALTHij (i = 1 ... 32, j = 1 ... 5)	health bits of the PLC modules (including Hot Standby CPUs)
%SW182 ... %SW183		
%SW641 ... %SW702	ERIO_MOD_HEALTH	Ethernet remote I/O module health bit status

NOTE: Refer to the Unity Pro Program Languages and Structure Reference Manual for a detailed explanation of system bits and words.

Viewing Diagnostics in Unity Pro

The bus editor in Unity Pro uses color animation to display the status of each drop, rack, or module on the **ERIO Bus**. The slot number of the drop/rack/module appears in red when a detected error is associated with that slot. For a module, the red display indicates the module is missing, inoperable, or improperly configured.

Status	Language Object	i	j
drop d	%SWi.j	152 + [(d-1)/16]	(d-1) module 16
rack r of drop d	%SWi	641 + [(d-1*2] + (r-1)	
module m, rack r, drop d	%SWi.j	641 + [(d-1)*2] + (r-1)	m-1

Device Data Types for the Remote I/O Modules

Device Data Types

The DDT structures for these remote I/O head modules are described elsewhere:

- 140 CRP 312 00 head module
- 140 CRA 312 00 drop module

These DDTs are available in the application. Refer to the Derived Data Types section *(see page 64)*.

The DDT diagnostics data is mapped to default local variables. The data is updated every MAST cycle.

6.4 Diagnostics through Modbus/TCP

Modbus Diagnostic Codes

Supported Diagnostic Codes

The 140 CRP 312 00 module and 140 CRA 312 00 adapter support these Modbus diagnostic codes

Diagnostic

Function code 8, subcode 22: Modbus function code 08 provides a variety of diagnostic functions:

Operation Code	Diag. Control	Description
0x01	0x0100	network diagnostic data
	0x0200	Read the Ethernet port diagnostic data from the switch manager.
	0x0300	Read the Modbus TCP/port 502 diagnostic data from the Modbus server.
	0x0400	Read the Modbus TCP/port 502 connection table from the Modbus server.
	0x07F0	Read the data structure offset data from the Modbus server.
0x02	0x0100	Clear the basic network diagnostic data. **NOTE:** Only specific parameters of basic network diagnostic data are used to clear requests.
	0x0200	Clear the Ethernet port diagnostic data. **NOTE:** Only specific parameters of basic network diagnostic data are used to clear requests.
	0x0300	Clear the Modbus TCP/port 502 diagnostic data. **NOTE:** Only specific parameters of Modbus port 502 diagnostic data are used to clear requests.
	0x0400	Clear the Modbus TCP/port 502 connection table. **NOTE:** Only specific parameters of Modbus port 502 connection data are use to clear requests.
0x03	0	Clear all diagnostic data. **NOTE:** Only specific parameters of each diagnostic data are used to clear requests.

Read Device Identification

Modbus function code 43, subcode 14: A Modbus request associated with function code 43 (Read Device Identification) asks a Modbus server to return the vendor name, product name, version number, and other optional fields:

Category	Object ID	Object Name	Type	Requirement
Basic	0x00	VendorName (vendor name)	ASCII string	mandatory
	0x01	ProductCode (product code)	ASCII string	mandatory
	0x02	MajorMinorRevision (version number)	ASCII string	mandatory
Regular	0x03	VendorUrl (vendor URL	ASCII string	optional
	0x04	ProductName (product name)	ASCII string	optional
	0x05	ModelName (model name)	ASCII string	optional
	0x06	UserApplicationName (user application name)	ASCII string	optional
	0x07...0x7F	(reserved)	ASCII string	optional
Extended	0x80...0xFF	device-dependent		optional

6.5 EtherNet/IP CIP Objects

Introduction

Quantum Ethernet I/O applications use CIP within a producer/consumer model to provide communication services in an industrial environment. This section describes the available CIP objects for Ethernet remote I/O network modules.

What's in this Section?

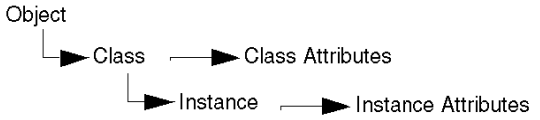
This section contains the following topics:

About CIP Objects

Overview

The Ethernet communication module can access CIP data and services located in connected devices. The CIP objects and their content depend on the design of each device.

CIP object data and content are exposed—and accessed—hierarchically in the following nested levels:



NOTE:

You can use explicit messaging to access either:

- a collection of instance attributes, by including in the explicit message address only the object's class and instance values, or
- a single attribute, by extending the explicit message address to include not only the object's class and instance values but also a specific attribute value

When the Ethernet communication module's local slave service is activated, remote devices can send explicit messages to the module's CIP object structure and:

- access module data, or
- execute module commands

This chapter describes the CIP objects the Ethernet communication module exposes to remote devices.

RSTP Diagnostics Object

Overview

The RSTP Diagnostics object presents the instances, attributes and services described below.

Class ID

355 (hex), 853 (decimal)

Instance IDs

The RSTP Diagnostics object presents these instance values:

- 0: class
- 1...*N*: instance

Attributes

RSTP Diagnostics object attributes are associated with each instance.

Instance ID = 0 (class attributes):

Attribute ID	Description	GET	SET
01	Revision: This attribute specifies the current revision of the RSTP Diagnostic Object. The revision is increased by 1 at each new update of the object.	X	—
02	Max Instance: This attribute specifies the maximum number of instances that may be created for this object on a per device basis (for example, an RSTP Bridge). There is 1 instance for each RSTP port on a device.	X	—
X = supported — = not supported			

Instance ID = 1 to *N* (instance attributes):

Attribute ID	Description	Type	GET	SET	Value
01	**Switch Status**	STRUCT	X	—	—
	Protocol Specification	UINT	X	—	Refer to RFC-4188 for attribute definitions and value range.
	Bridge Priority	UDINT	X	—	
	Time Since Topology Change	UDINT	X	—	
	Topology Change Count	UDINT	X	—	Refer to RFC-4188 for attribute definitions and value range. Do not clear this Get_Only counter.
	Designated Root	String	X	—	Refer to RFC-4188 for attribute definitions and value range.
	Root Cost	UDINT	X	—	
	Root Port	UDINT	X	—	
	Max Age	UINT	X	—	
	Hello Time	UINT	X	—	
	Hold Time	UDINT	X	—	
	Forward Delay	UINT	X	—	
	Bridge Max Age	UINT	X	—	
	Bridge Hello Time	UINT	X	—	
	Bridge Forward Delay	UINT	X	—	
X = supported — = not supported					

Attribute ID	Description	Type	GET	SET	Value
02	**Port Status**	STRUCT	X	—	—
	Port	UDINT	X	—	Refer to RFC-4188 for attribute definitions and value range.
	Priority	UDINT	X	—	
	State	UINT	X	—	
	Enable	UINT	X	—	
	Path Cost	UDINT	X	—	
	Designated Root	String	X	—	
	Designated Cost	UDINT	X	—	
	Designated Bridge	String	X	—	
	Designated Port	String	X	—	
	Forward Transitions Count	UDINT	X	—	Refer to RFC-4188 for attribute definitions and value range. Services: ● Get_and_Clear: The current value of this parameter is returned with the response message. ● other services: The current value of this parameter is returned without being cleared.
03	**Port Mode**	STRUCT	—	—	—
	Port Number	UINT	X	—	This attribute indicates the port number for a data query. The value range is configuration dependent. For a 4-port Ethernet device, as an instance, the valid range is 1...4.
	Admin Edge Port	UINT	X	—	This attribute indicates if this is a user-configured edge port: ● 1: true ● 2: false Other values are not valid.
	Oper Edge Port	UINT	X	—	This attribute indicates if this port is currently an edge port: ● 1: true ● 2: false Other values are not valid.
	Auto Edge Port	UINT	X	—	This attribute indicates if this port is a dynamically determined edge port: ● 1: true ● 2: false Other values are not valid.
X = supported — = not supported					

Services

The RSTP Diagnostics object performs these services:

Service ID		Description	Class	Instance	Notes
hex	**dec**				
01	01	Get_Attributes_All	X	X	This service returns: • all attributes of the class • all attributes of the instance of the object
02	02	Get_Attribute_Single	X	X	This service returns: • the contents of a single attribute of the class • the contents of the instance of the object as specified Specify the attribute ID in the request for this service.
32	50	Get_and_Clear	—	X	This service returns the contents of a single attribute of the instance of the object as specified. Then the relevant counter-like parameter(s) within the specified attribute are cleared. (Specify the attribute ID in the request for this service.)
X = supported — = not supported					

Service Port Control Object

Overview

The Service Port Control object is defined for port control purposes.

Class ID

400 (hex), 1024 (decimal)

Instance IDs

The Service Port Control object presents these instance valuess:

- 0: class
- 1: instance

Attributes

Service Port Control object attributes are associated with each instance.

Required class attributes (instance 0):

Attribute ID	Description	Get	Set
01	Revision	X	—
02	Max Instance	X	—
X = supported — = not supported			

Required instance attributes (instance 1):

Attribute ID		Description	Type	Get	Set	Value
hex	dec					
01	01	Port Control	UINT	X	X	0 (default): disabled 1: access port 2: port mirroring 3: extended port

Attribute ID		Description	Type	Get	Set	Value
hex	dec					
02	02	Mirror	UINT	X	X	bit 0 (default): ETH-2 port bit 1: ETH-3 port bit 2: ETH-4 port bit 3: internal port
X = supported — = not supported						

NOTE:

- If the SERVICE port is not configured for port mirroring, the mirror attribute is ignored. If the value of a parameter request is outside the valid range, the service request is ignored.
- In port mirroring mode, the SERVICE port acts like a read-only port. That is, you cannot access devices (ping, connection to Unity Pro, etc.) through the SERVICE port.

Services

The Service Port Control object performs these services for these object types:

Service ID		Name	Class	Instance	Description
hex	dec				
01	01	Get_Attributes_All	X	X	Get all attributes in a single message.
02	02	Set_Attributes_All	—	X	Set all attributes in a single message.
0E	14	Get_Attribute_Single	X	X	Get a single specified attribute.
10	16	Set_Attribute_Single	—	X	Set a single specified attribute.
X = supported — = not supported					

6.6 Diagnostics through Unity Pro

What's in this Section?

This section contains the following topics:

Device Services

Access the Device Services Tab

The Unity Pro IP configuration parameters apply to the 140 CRP 312 00 head module in the local rack. To access the **Device Services** tab, double-click on the 140 CRP 312 00 module *(see page 47)*.

Device Services Parameters

These parameters are found on the Unity Pro **Device Services** tab:

Field	Parameter	Description
Network Card	Card	IP address of the PC
CRP Diagnostics (See below.)	• Connect • Disconnect	connection to the 140 CRP 312 00
	• Online Action • EtherNet/IP Explicit Message	
	Apply	apply configuration

Access Online Action

In the **CRP Diagnostics** field, select **Connect** to connect to the PLC and press **Apply** to access the configuration tabs for **Online Action** or **EtherNet/IP Explicit Message**:

- **Online Action** configuration tabs:
  - EtherNet/IP Objects *(see page 116)*
  - Service Port *(see page 117)*
  - Ping *(see page 119)*
- EtherNet/IP Explicit Message *(see page 82)*

EtherNet/IP Objects

View Parameters

Use the **EtherNet/IP Objects** tab to view available EtherNet/IP parameters:

Step	Action	Comment
1	In Unity Pro, access the module for Online Action.	Refer to Online Action *(see page 115)*.
2	Double-click on the 140 CRP 312 00 module in the Unity Pro rack view.	
3	Select the **EtherNet/IP Objects** tab.	View these parameters: • **Group/Parameters** • **Value** • **Unit**
4	Press **Refresh**.	This action updates the screen with current parameters.

Service Port Management (Online Action)

Introduction

Configure the SERVICE port for the 140 CRP 312 00 module on the Unity Pro **Service Port** tab

Access the Service Port Tab

Step	Action
1	In Unity Pro, access the module for Online Action. Refer to Online Action *(see page 115)*.
2	Double-click on the 140 CRP 312 00 module in the Unity Pro rack view.
3	Select the **Service Port** tab.

Service Port Parameters

Field	Parameter	Value		Comment
Service Port Mode	**Access** (default)	ETH1		You cannot edit the value in the **Service Port Number** field.
	Mirroring	ETH1		
Access Port Configuration	**Service Port Number**	ETH1		**Service Port Mode** = Mirroring (see note)
		ETH1		**Service Port Mode** = any available source port
Port Mirroring Configuration	**Source Port(s)**	Internal Port	Yes	all Ethernet traffic destined for the module
			No	
		ETH2	Yes	all traffic through the 140 CRP 312 00 INTERLINK port
			No	
		ETH3	Yes	all Ethernet traffic through the first remote I/O port
			No	
		ETH4	Yes	all Ethernet traffic through the second remote I/O port
			No	
Description	—	—	—	description of the source port
NOTE: In port mirroring mode, the SERVICE port acts like a read-only port. That is, you cannot access devices (ping, connection to Unity Pro, etc.) through the SERVICE port.				

Buttons on the **Service Port** tab:

Button	Description
Update	After you change **Service Port** parameters, press this button so that the module can use the new configuration.
Refresh	This button reads the latest **Service Port** configuration from the module.

On Line Behavior

The **Service Port** parameters are stored in the application, but you can reconfigure (change) the parameters in connected mode. Values that you reconfigure in connected mode are sent to the 140 CRP 312 00 module through explicit messages. (The changed values are not stored, so a mismatch can exist between the parameters that are being used and those in the stored application.) If the module does not respond to the explicit messages, a message appears.

Limitations

The SERVICE port on the 140 CRP 312 00 module has the same limitations as the cloud port of the dual-ring switch (DRS). Therefore, the module's cloud port and the DRS's cloud port can be connected to the same equipment.

For more information about considerations that apply to the use of the distributed I/O cloud port on the DRS, refer to "Predefined Configuration Files" in the PlantStruxure Quantum Ethernet I/O System Planning Guide.

Pinging a Network Device

Introduction

Use the Unity Pro ping function to send an ICMP echo request to an Ethernet target device. The request determines if the target device is present. If the target device is present, the request determines the time elapsed until an echo response from the target device is received.

Access the Ping Tab

Step	Action
1	In Unity Pro, access the module for Online Action *(see page 115)*.
2	Double-click on the 140 CRP 312 00 head module in the Unity Pro rack view.
3	Select the **Ping** tab.

Select a Target Device

Select the communication module that you want to ping.

In the Online Action window *(see page 115)*, select a device to ping. The window displays pages containing online information for the selected device.

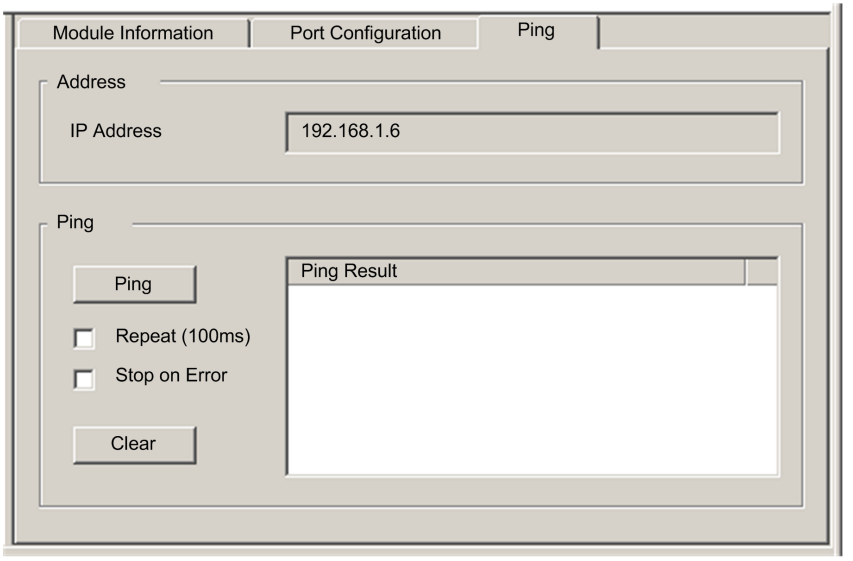
NOTE: The target device is identified by its IP address setting. Unity Pro verifies that the target address is not one of these:

- loopback address (127.000.000.000 to 127.255.255.255)
- multicast address (224.000.000.000 to 239.255.255.255)
- reserved address (240.000.000.000 to 255.255.255.255)
- broadcast address

NOTE: The specific collection of displayed pages depends on the type of device selected:

- the communication module
- a remote EtherNet/IP device
- a remote Modbus TCP device

The Ping Tab



Parameters

Ping parameters:

Field	Parameter	Value	Comment
Address	IP Address	(See note.)	IP address of the target module to ping.
Ping	Repeat (100ms)	checked	Ping once.
		unchecked	Ping every 100 ms.
	Stop on Error	checked	Stop pinging when a communication error is detected.
		unchecked	Continue pinging when a communication error is detected.
	Ping (button)	—	Start pinging. (Click again to stop repeated pinging when no error is detected.)
	Ping Result	—	This box reports the response to the ping.
	Clear (button)	—	Click this button to clear (empty) **Ping Result**.

Firmware Upgrade

7

Introduction

This chapter describes the steps for upgrading the firmware for your 140 CRP 312 00 head module and 140 CRA 312 00 adapter module.

What's in this Chapter?

This chapter contains the following topics:

140 CRP 312 00 Firmware Upgrade

OS

Use the Unity Pro OS to upgrade the firmware on the 140 CRP 312 00 module. OS Loader was installed on your PC when you installed Unity Pro. (The minimum required version of OS Loader is V6.0. The compatible version is included with your copy of Unity Pro.)

A complete firmware upgrade includes the installation of these discrete files:
- kernel
- exec

The kernel and exec files are installed independently. Therefore, perform the firmware upgrade process two times (once for each file).

The name of the firmware file indicates the upgrade type (kernel or exec). Examples:
- kernel file name: `CCS1_Noc_Kerl_OSLoader.bin`
- exec file name: `CCS1_Noc_Exec_OSLoader.bin`

NOTE: These instructions assume you are familiar with Unity Pro. For more information about the OS Loader, refer the chapter “OSLoader Screens” in the *Unity Pro OSLoader User Manual* (35006156).

Upgrade Procedure

Follow the procedure, below, to upgrade either the firmware kernel or the firmware exec.

NOTE:

- We recommend that you update the kernel before you upgrade the exec. Both firmware upgrade files are installed in the same manner. The only difference is the name of the file you select.
- Make sure there is no interruption to power or communications during the firmware upgrade process. Otherwise, the 140 CRP 312 00 module can be damaged.

Step	Action	Comment
1	Connect the PC that is running the Unity Pro OS Loader directly to one of the module ports.	Available ports: ● SERVICE port (140 CRP 312 00 or 140 CRA 312 00) ● INTERLINK port (140 312 00) ● DRS port that is configured for a distributed I/O cloud
2	Launch OS Loader.	**Start** → **Programs** → **Schneider Electric** → **SoCollaborative** → **OS Loader**.
3	Click **Next** to continue.	Go directly to the first installation step.

Step	Action	Comment
4	Select the **FTP** communication driver and press **Next** to continue.	The next screen displays a list of devices discovered by OS Loader. It also displays the FTP address for each discovered device.
5	In the **Target Address** area, type in the **FTP Address** of the 140 CRP 312 00 module that is the target of the upgrade.	—
6	Click **Next** to continue. Perform these tasks at the next installation screen: **a** Select **Download OS to device**. **b** Click the **Browse** button to navigate to and select the desired firmware upgrade file.	—
7	Click **Next**. Perform these tasks at the next installation screen: **a** Compare the selected firmware **File** against the firmware already loaded in the **Device**. **b** Confirm that the **Hardware ID** for both the file and the device are the same	—
8	Click **Next**. On the summary page, click **Download**.	The OS Loader displays the progress of the FTP session. When it displays the word **SUCCESS** the download is complete.
9	Click **Close**.	The firmware download is finished.

The upgrade process takes approximately 2 minutes:
- firmware upgrade (1 minute)
- reboot, reestablish I/O connections (1 minute)

NOTE: During the firmware upgrade, the I/O communications with the 140 CRA 312 00 adapter are interrupted. After the Hold up time *(see page 60)* expires, the I/O modules return to their fallback state.

Hot Standby

Use these steps to upgrade the 140 CRP 312 00 firmware in Hot Standby configurations:

Step	Action
1	Follow the above steps to upgrade the firmware for the 140 CRP 312 00 in the standby rack. **NOTE:** During the firmware upgrade, the I/O communications with the 140 CRA 312 00 adapter and the 140 CRP 312 00 module in the primary rack are not interrupted. However, the standby I/O communications with the 140 CRA 312 00 adapter are interrupted.
2	When the firmware on the 140 CRP 312 00 in the standby rack is upgraded, perform a manual switch-over that gives the newly upgraded standby rack the role of primary rack.
3	To facilitate future Hot Standby switch-overs, you should now upgrade the firmware for the 140 CRA 312 00 in the (new) standby rack.

140 CRA 312 00 Firmware Upgrade

Overview

Use these procedures to upgrade the firmware for the 140 CRA 312 00 remote I/O adapter:

Stage	Description
1	Download and install Unity Loader software.
2	Configure and store IP parameters (optional).
3	Connect your configuration PC to the remote I/O adapter.
4	Transfer the firmware upgrade to the remote I/O adapter.

The minimum required version of Unity Loader is V2.2.

Downloading and Installing Unity Loader

Download the Unity Loader software to your PC:

Step	Action
1	Enter the web address for Schneider Electric (www.schneider-electric.com) in an Internet browser.
2	In the **Search from input field**, enter the phrase **Unity Loader** and press `Enter`.
3	Examine the search results and select the appropriate entry for the Unity Loader software. **NOTE:** You can select the **Download** → **Softwares** menu command to filter the results.
4	Follow the on-screen instructions to download both the Unity Loader installation software and any necessary installation instructions.
5	Run the Unity Loader setup file and follow the instructions (on the screen and in the downloaded documentation) to install Unity Loader.

Default Address Configurations

You have the option to configure and store IP parameters for the 140 CRA 312 00 adapter when these conditions are met:

- The rotary switch setting is **Stored**.
- You have not configured and stored valid IP parameters

The 140 CRA 312 00 uses these default address configurations:

Parameter	Description
Default IP Address	The default IP address starts with 10.10 and uses the last two bytes of the MAC address. As an example, a device with the MAC address of 00:00:54:10:8A:05 has a default IP address of 10.10.138.5 (0x8A=138, 0x05=5).
Default Sub-Network Mask	The default address is 255.0.0.0 (a class A mask).
Default Gateway Address	The default gateway address is identical to the default IP address.

The default address is based on the 140 CRA 312 00 MAC address. This makes it possible for several Schneider Electric devices to use their default network configurations on the same network.

To use a specific set of IP parameters, you must store them in the 140 CRA 312 00. Set the rotary switches to the **Stored** position.

You can send an EtherNet/IP explicit message *(see page 75)* to the TCP/IP interface object of the module to store the configured IP parameters.

NOTE: The 140 CRA 312 00 adapter uses the stored IP parameters only after a power cycle.

Connect the Configuration PC to the Remote I/O Adapter

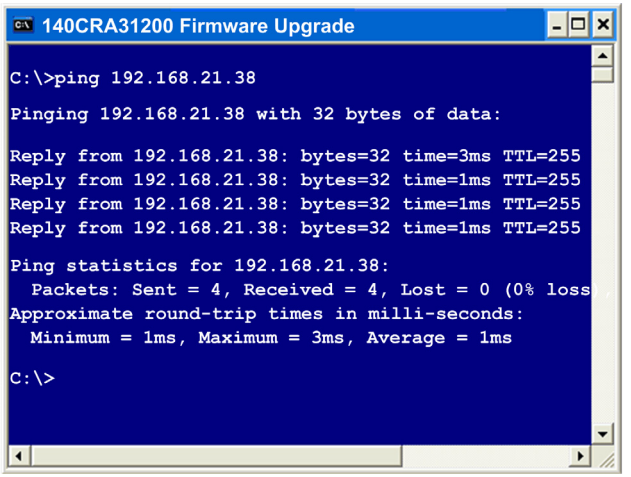
Connect your configuration PC (that is running Unity Loader) directly to the Quantum Ethernet I/O adapter module (140 CRA 312 00). Available ports:

- SERVICE port
- DRS port that is configured for a distributed I/O cloud

Verify that communications are established between the PC and the adapter by issuing a Ping command from the PC:

Step	Action	Comment
1	Open a command window on the PC.	**Start** → **Run**.
2	In the **Run** dialog, type in **cmd**.	
3	Click **OK**.	
4	At the command prompt, type in the ping command and the device IP address.	Example: `C:\>ping 192.168.21.38`:

The command window verifies that a connection is established:



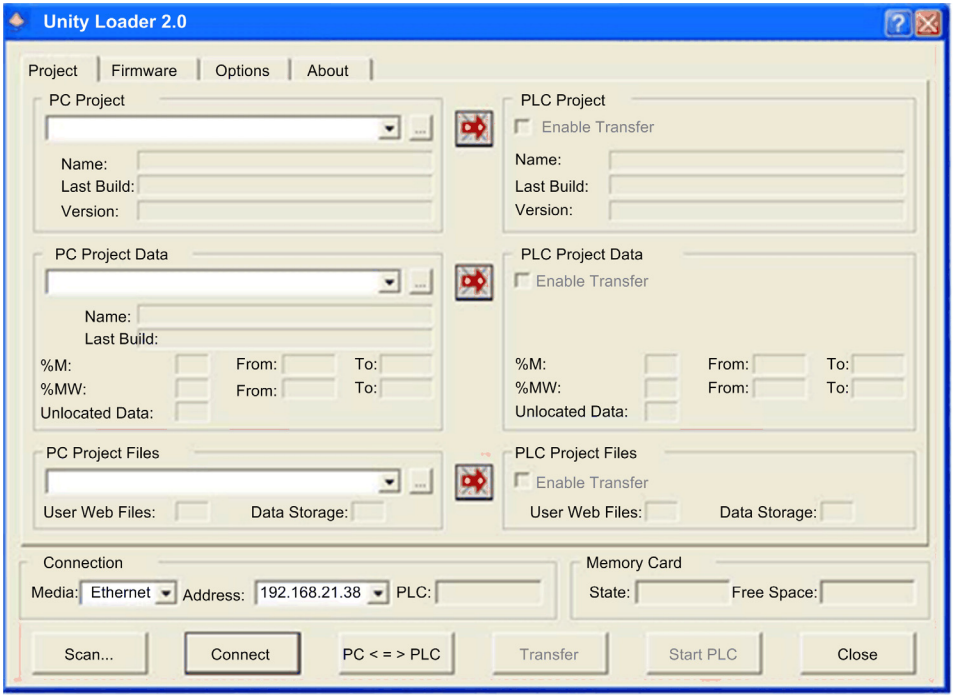
Upgrade Procedure

The firmware download process should not be interrupted:

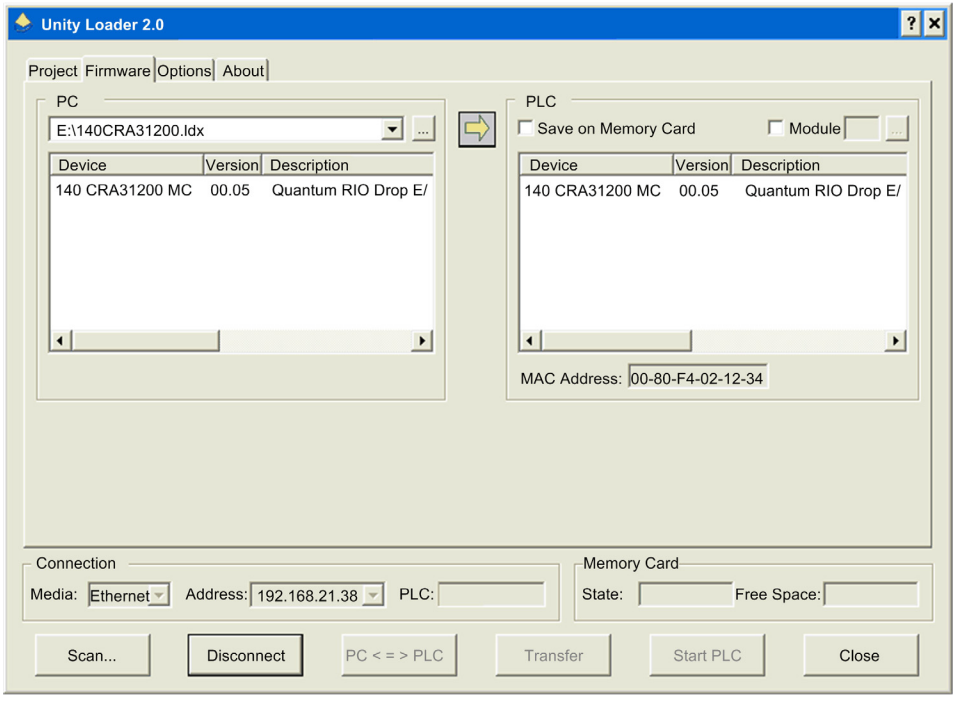
- Do not allow an interruption to the power or the communications during the firmware upgrade process.
- Do not shut down the Unity Loader software during the upgrade.

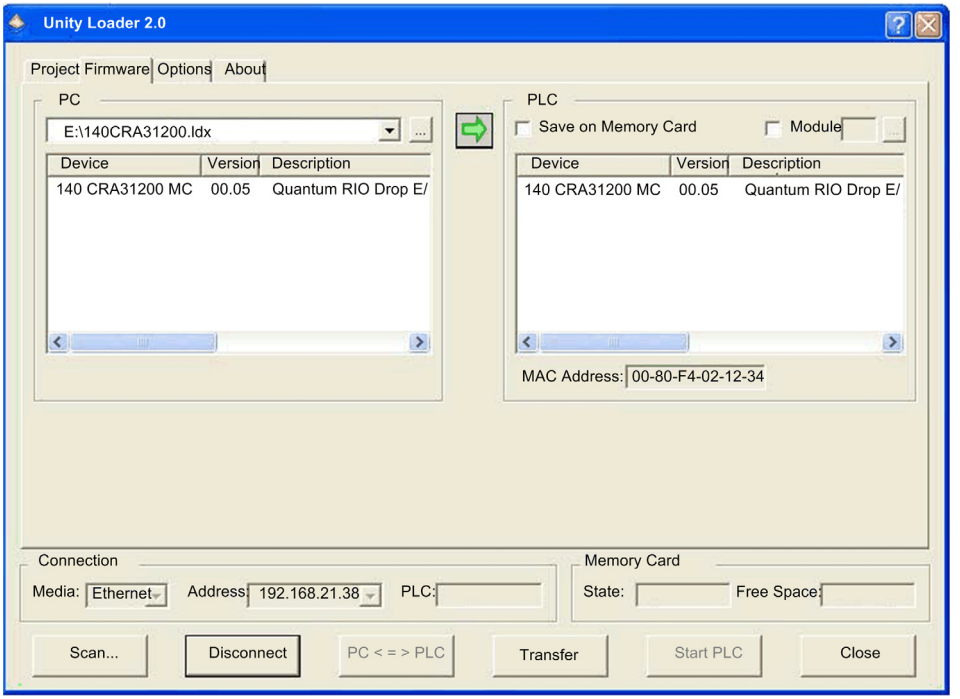
If the firmware download process is interrupted, the new firmware is not installed and the adapter continues to use the old firmware. If an interruption occurs, restart the process.

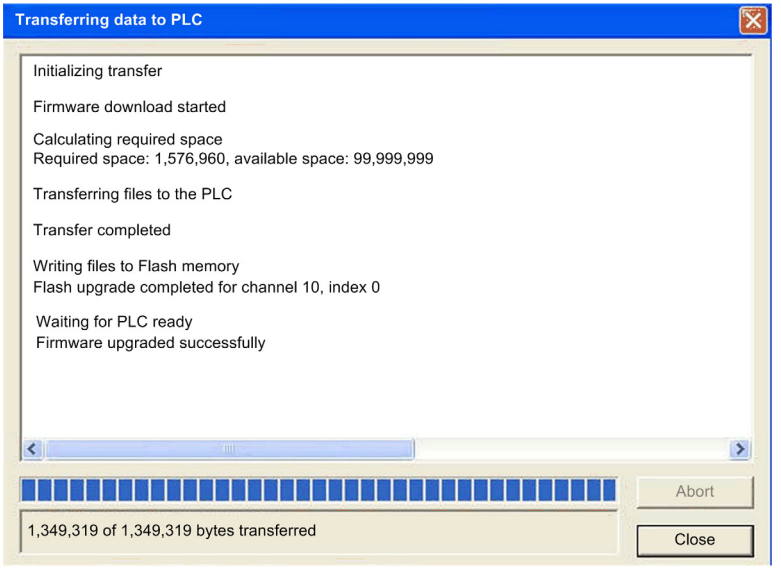
Open Unity Loader on your PC and update the firmware for the 140 CRA 312 00 remote I/O adapter:

Step	Action
1	Open Unity Loader on your PC. (**Start** → **Programs** → **Schneider Electric** → **Unity Loader**) Unity Loader opens and displays the **Project** tab 

2	In the **Connection** area of the **Project** page, connect to the module:
	• In the **Media** list, select **Ethernet**.
	• In the **Address** field, type in the adapter's IP address, which will be either:
	  • *configured*: The 140 CRA 312 00 module is already communicating on the network and the IP address for the module is configured in the application *(see page 52)*.
	  • *default*: The 140 CRA 312 00 rotary switch position is **Stored** and you did not already store valid IP parameters.
	• Click **Connect**.

Step	Action
3	After Unity Loader has connected to the module, click on the **Firmware** tab: 

Step	Action
4	In the **PC** area, click the ellipsis (**...**) button to open a dialog where you can navigate to and select the firmware file for the network connectivity module. The firmware is contained in a Unity Loader file (.ldx extension). After you select the firmware file and close the dialog, the selected revision of this firmware is displayed in the list on the left, and the current version of the firmware is displayed in the list on the right. 
5	When the arrow in the middle of the screen (above) is green, click **Transfer**. **NOTE:** Only click **Transfer** if the arrow is green. A yellow arrow indicates that the firmware file on your computer is the same version or newer than the file selected for transfer; a red arrow indicates that the computer's firmware is not compatible with the 140 CRA 312 00 remote I/O adapter. **NOTE:** Do not use the **Stop PLC**/**Start PLC** button when updating firmware for the network connectivity module.

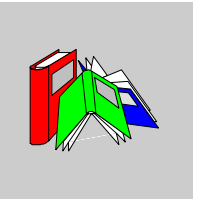
Step	Action
6	Click **yes** on the two dialogs that appear. A third dialog appears (below), which indicates the transfer status with the blue bars at the bottom of the screen. After the transfer is complete, click **Close**.  **NOTE:** If you are upgrading firmware for more than one 140 CRA 312 00 remote I/O adapter, additional dialogs will appear. Click **yes** to close each dialog.
7	In the Unity Loader software, click **Disconnect** and close the window.
8	Reboot the module to finalize the firmware update.

The upgrade process takes approximately 2 minutes:

- firmware upgrade (1 minute)
- reboot, reestablish I/O connections (1 minute)

During the firmware upgrade, the I/O communications with the 140 CRA 312 00 module may be interrupted. After the Hold up time *(see page 60)* expires, the I/O modules return to their fallback state.

Glossary



0-9

%I

According to the CEI standard, %I indicates a language object of type discrete IN.

%IW

According to the CEI standard, %IW indicates a language object of type analog IN.

%M

According to the CEI standard, %M indicates a language object of type memory bit.

%MW

According to the CEI standard, %MW indicates a language object of type memory word.

%Q

According to the CEI standard, %Q indicates a language object of type discrete OUT.

%QW

According to the CEI standard, %QW indicates a language object of type analog OUT.

%SW

According to the CEI standard, %SW indicates a language object of type system word.

A

adapter

The target of real-time I/O data connection requests from scanners. It cannot send or receive real-time I/O data unless it is configured to do so by a scanner, and it does not store or originate the data communications parameters necessary to establish the connection. An adapter accepts explicit message requests (connected and unconnected) from other devices.

advanced mode

A selection in Unity Pro that displays expert-level configuration properties that help define Ethernet connections. Because these properties should be edited only by people with a good understanding of EtherNet/IP communication protocols, they can be hidden or displayed, depending upon the qualifications of the specific user.

architecture

A framework for the specification of a network, constructed on the following:
- physical components and their functional organization and configuration
- operational principles and procedures
- data formats used in its operation

array

A table containing elements of a single type.

The syntax is as follows: `array [<limits>] OF <Type>`

Example:

`array [1..2] OF BOOL` is a one-dimensional table with two elements of type `BOOL`.

`array [1..10, 1..20] OF INT` is a two-dimensional table with 10x20 elements of type `INT`.

ART

(*application response time*) The time a PLC application takes to react to a given input. ART is measured from the time a physical signal in the PLC turns on and triggers a write command until the remote output turns on to signify that the data has been received.

B

BOOL

(*boolean type*) The basic data type in computing. A BOOL variable can have either of the following two values: 0 (FALSE) or 1 (TRUE).

A bit extracted from a word is of type BOOL, for example: %MW10.4.

BOOTP

(*bootstrap protocol*) A UDP network protocol that can be used by a network client to automatically obtain an IP address from a server. The client identifies itself to the server using its MAC address. The server, which maintains a pre-configured table of client device MAC addresses and associated IP addresses, sends the client its defined IP address. The BOOTP service utilizes UDP ports 67 and 68.

broadcast

A message sent to all devices in the subnet.

C

CCOTF

(*change configuration on the fly*) A feature of Unity Pro that allows a PLC hardware change in the system configuration while the PLC is operating and not impacting other active drop operations.

CIP™

(*common industrial protocol*) A comprehensive suite of messages and services for the collection of manufacturing automation applications — control, safety, synchronization, motion, configuration and information. CIP allows users to integrate these manufacturing applications with enterprise-level Ethernet networks and the internet. CIP is the core protocol of EtherNet/IP.

class 1 connection

A CIP transport connection used for I/O data transmission via implicit messaging between EtherNet/IP devices.

class 3 connection

A CIP transport connection used for explicit messaging between EtherNet/IP devices.

connected messaging

Using a CIP connection for communication that establishes a relationship between 2 or more application objects on different nodes. The connection establishes a virtual circuit in advance for a particular purpose, such as frequent explicit messages or real-time I/O data transfers.

connection

A virtual circuit between 2 or more network devices, created prior to the transmission of data. After a connection is established, a series of data is transmitted over the same communication path, without the need to include routing information — including source and destination address — with each piece of data.

connection originator

The EtherNet/IP network node that initiates a connection request for I/O data transfer or explicit messaging.

connectionless

Communication between 2 network devices, where data is sent without prior arrangement between the devices. Each piece of transmitted data includes routing information — including source and destination address.

control network

An Ethernet-based network containing PLCs, SCADA systems, an NTP server, PCs, AMS, switches, etc. Two kinds of topologies are supported:

- flat — Devices in this network belong to the same subnet.
- 2 levels — The network is split into an operation network and an inter-controller network. These 2 networks can be physically independent, but are generally linked by a routing device.

D

DDT

(*derived data type*) A set of elements with the same type (`array`) or with different types (structure).

determinism

For a defined application and architecture, the ability to predict that the delay between an event (change of an input value) and the corresponding change of an output state is a finite time *t*, smaller than the time required for your process to run correctly.

device network

An Ethernet-based network within a remote I/O network that contains both remote I/O and distributed I/O devices. Devices connected on this network follow specific rules to allow remote I/O determinism.

DFB

(*derived function block*) Function blocks that can be defined by the user in ST, IL, LD or FBD language.

Using these DFB types in an application makes it possible to:
- simplify the design and entry of the program
- make the program easier to read
- make it easier to debug
- reduce the amount of code generated

DHCP

(*dynamic host configuration protocol*) An extension of the BOOTP communications protocol that provides for the automatic assignment of IP addressing settings—including IP address, subnet mask, gateway IP address, and DNS server names. DHCP does not require the maintenance of a table identifying each network device. The client identifies itself to the DHCP server using either its MAC address, or a uniquely assigned device identifier. The DHCP service utilizes UDP ports 67 and 68.

distributed I/O cloud

A group of distributed I/O devices connected either to a non-ring port on a DRS or to a distributed I/O communications module in the local rack. Distributed I/O clouds are single-point connections to the Quantum EIO network and are not required to support RSTP.

distributed I/O device

Any Ethernet device (Schneider Electric device, PC, servers, or third-party devices) that supports I/O exchange with a PLC or other Ethernet communication service.

distributed I/O network

A network containing distributed I/O devices that integrates a unique standalone PLC or a unique Hot Standby system. I/O scanning may be performed by a communication module interlinked with a remote I/O head module on the local rack of an Ethernet remote I/O system. Distributed I/O network traffic is delivered after remote I/O traffic, which takes priority in an Ethernet remote I/O network.

DNS

(*domain name server/service*) A service that translates an alpha-numeric domain name into an IP address, the unique identifier of a device on the network.

domain name

An alpha-numeric string that identifies a device on the internet, and which appears as the primary component of a web site's uniform resource locator (URL). For example, the domain name *schneider-electric.com* is the primary component of the URL *www.schneider-electric.com*.

Each domain name is assigned as part of the domain name system, and is associated with an IP address.

Also called a host name.

DRS

(*dual-ring switch*) A ConneXium extended managed switch with one of several possible predefined configurations downloaded to it so that it can participate in a Quantum EIO network. A DRS provides 2 RSTP-enabled ring connections, one for the main ring and one for a sub-ring. It also manages QoS, which provides a predictable level of performance for both remote I/O and distributed I/O traffic on the same I/O network.

DRSs require a firmware version 6.0 or later.

DT

(*date and time*) A data type encoded in BCD in a 64-bit format that contains the following information:

- the year encoded in a 16-bit field
- the month encoded in an 8-bit field
- the day encoded in an 8-bit field
- the time encoded in an 8-bit field
- the minutes encoded in an 8-bit field
- the seconds encoded in an 8-bit field

NOTE: The 8 least significant bits are not used.

The `DT` type is entered as follows:

`DT#``<Year>`**`-`**`<Month>`**`-`**`<Day>`**`-`**`<Hour>`**`:`**`<Minutes>`**`:`**`<Seconds>`

This table shows the upper/lower limits of each field:

Field	Limits	Comment
Year	[1990,2099]	Year
Month	[01,12]	The leading 0 is displayed; it can be omitted during data entry.
Day	[01,31]	For months 01/03/05/07/08/10/12
	[01,30]	For months 04/06/09/11
	[01,29]	For month 02 (leap years)
	[01,28]	For month 02 (non-leap years)
Hour	[00,23]	The leading 0 is displayed; it can be omitted during data entry.
Minute	[00,59]	The leading 0 is displayed; it can be omitted during data entry.
Second	[00,59]	The leading 0 is displayed; it can be omitted during data entry.

DTM

(*device type manager*) A device driver running on the host PC. It provides a unified structure for accessing device parameters, configuring and operating the devices, and troubleshooting the network. DTMs can range from a simple graphical user interface (GUI) for setting device parameters to a highly sophisticated application capable of performing complex real-time calculations for diagnosis and maintenance purposes. In the context of a DTM, a device can be a communications module or a remote device on the network.

See *FDT*.

E

EDS

(*electronic data sheet*) Simple text files that describe the configuration capabilities of a device. EDS files are generated and maintained by the manufacturer of the device.

EF

(*elementary function*) A block used in a program to perform a predefined logical function.

A function does not have any information on the internal state. Several calls to the same function using the same input parameters will return the same output values. You will find information on the graphic form of the function call in the [*functional block (instance)*]. Unlike a call to a function block, function calls include only an output which is not named and whose name is identical to that of the function. In FBD, each call is indicated by a unique [number] via the graphic block. This number is managed automatically and cannot be modified.

Position and configure these functions in your program in order to execute your application.

You can also develop other functions using the SDKC development kit.

EFB

(*elementary function block*) A block used in a program to perform a predefined logical function.

EFBs have states and internal parameters. Even if the inputs are identical, the output values may differ. For example, a counter has an output indicating that the preselection value has been reached. This output is set to 1 when the current value is equal to the preselection value.

EN

(*enable*) An optional block input. When enabled, an `ENO` output is set automatically.

If `EN` = 0, the block is not enabled; its internal program is not executed, and `ENO` is set to 0.

If `EN` = 1, the block's internal program is run and `ENO` is set to 1. If a runtime error is detected, `ENO` is set to 0.

If the `EN` input is not connected, it is set automatically to 1.

endianness

For multi-byte numbers, the big-endian and little-endian formats indicate the byte order in stored memory. In big-endian format, the most significant byte is stored in the lowest (first) address. In little-endian format, the least significant byte is stored in the lowest address. These examples show the contents of four memory bytes (address *x* ... address *x* + 3) for the multi-byte number 0A0B0C0D (h):

- big endian: *x* = 0A; *x* + 1 = 0B; *x* + 2 = 0C; *x* + 3 = 0D
- little endian: *x* = 0D; *x* + 1 = 0C; *x* + 2 = 0B; *x* + 3 = 0A

It is perhaps easier to remember these by their uncorrupted forms, which indicate that you first put the "big end in" (big endian) or "little end in" (little endian).

ENO

error notification The output associated with the optional input `EN`.

If `ENO` is set to 0 (either because `EN` = 0 or if a runtime error is detected):

- The status of the function block outputs remains the same as it was during the previous scanning cycle that executed correctly.
- The output(s) of the function, as well as the procedures, are set to 0.

Ethernet

A 10 Mb/s, 100 Mb/s, or 1 Gb/s, CSMA/CD, frame-based LAN that can run over copper twisted pair or fiber optic cable, or wireless. The IEEE standard 802.3 defines the rules for configuring a wired Ethernet network; the IEEE standard 802.11 defines the rules for configuring a wireless Ethernet network. Common forms include 10BASE-T, 100BASE-TX, and 1000BASE-T, which can utilize category 5e copper twisted pair cables and RJ45 modular connectors.

EtherNet/IP™

A network communication protocol for industrial automation applications that combines the standard internet transmission protocols of TCP/IP and UDP with the application layer common industrial protocol (CIP) to support both high speed data exchange and industrial control. EtherNet/IP employs electronic data sheets (EDS) to classify each network device and its functionality.

explicit messaging

TCP/IP-based messaging for Modbus TCP and EtherNet/IP. It is used for point-to-point, client/server messages that include both data—typically unscheduled information between a client and a server—and routing information. In EtherNet/IP, explicit messaging is considered class 3 type messaging, and can be connection-based or connectionless.

explicit messaging client

(*explicit messaging client class*) The device class defined by the ODVA for EtherNet/IP nodes that only support explicit messaging as a client. HMI and SCADA systems are common examples of this device class.

F

FBD

(*function block diagram*) A graphical programming language that works like a flowchart. By adding simple logical blocks (`AND`, `OR`, etc.), each function or function block in the program is represented in this graphical format. For each block, the inputs are on the left and the outputs on the right. Block outputs can be linked to inputs of other blocks in order to create complex expressions.

FDR

(*faulty device replacement*) A service that uses configuration software to replace an inoperable device.

FDT

(*field device tool*) The technology that harmonizes communication between field devices and the system host.

FTP

(*file transfer protocol*) A protocol that copies a file from one host to another over a TCP/IP-based network, such as the internet. FTP uses a client-server architecture as well as separate control and data connections between the client and server.

full duplex

The ability of 2 networked devices to independently and simultaneously communicate with each other in both directions.

G

gateway

A device that interconnects 2 different networks — sometimes with different network protocols. When used to connect networks based on different protocols, a gateway converts a datagram from one protocol stack into the other. When used to connect 2 IP-based networks, a gateway (also called a router) has 2 separate IP addresses – one on each network.

global data

Global data provides the automatic exchange of data variables for the coordination of PLC applications.

H

harsh environment

Resistance to hydrocarbons, industrial oils, detergents and solder chips. Relative humidity up to 100%, saline atmosphere, significant temperature variations, operating temperature between - 10°C and + 70°C, or in mobile installations.

high-capacity daisy chain loop

Often referred to as HCDCL, a high-capacity daisy chain loop uses DRSs to extend the distance between remote I/O drops or connect sub-rings (containing remote I/O drops or distributed I/O devices) and/or distributed I/O clouds to the Ethernet remote I/O network.

Hot Standby

A high-availability Quantum control system with a second (standby) PLC that maintains up-to-date system status. If the primary PLC becomes inoperable, the standby PLC takes control of the system.

HTTP

(*hypertext transfer protocol*) A networking protocol for distributed and collaborative information systems. HTTP is the basis of data communication for the web.

I

I/O scanning

Continuously polling the I/O modules to collect data and status, event, and diagnostics information. This process monitors inputs and controls outputs.

IEC 61131-3

International standard: programmable logic controllers

Part 3: programming languages

IGMP

(internet group management protocol) This internet standard for multicasting allows a host to subscribe to a particular multicast group.

IL

(*instruction list*) A series of basic instructions similar to assembly language used to program processors. Each instruction is made up of an instruction code and an operand.

implicit messaging

UDP/IP-based class 1 connected messaging for EtherNet/IP. Implicit messaging maintains an open connection for the scheduled transfer of control data between a producer and consumer. Because an open connection is maintained, each message contains primarily data — without the overhead of object information — and a connection identifier.

INT

(*integer*) (encoded in 16 bits) The upper/lower limits are as follows: -(2 to the power of 15) to (2 to the power of 15) - 1.

Example:

```
-32768, 32767, 2#1111110001001001, 16#9FA4.
```

inter-controller network

An Ethernet-based network that is part of the control network, and provides data exchange between controllers and engineering tools (programming, asset management system (AMS)).

interlink port

An Ethernet port on Ethernet remote I/O modules allowing direct connection of distributed I/O modules to the remote I/O network.

IP address

The 32-bit identifier — consisting of both a network address and a host address — assigned to a device connected to a TCP/IP network.

isolated distributed I/O network

An Ethernet-based network containing distributed I/O devices that do not participate in an Ethernet remote I/O network.

J

jitter

Jitter is the time variation in the delivery of an Ethernet packet, caused by packet queuing along its network travel path. Jitter can be reduced to predictable amounts by applying packet handling policies—e.g. quality of service (QoS)—that grant priority to the packets of a specified type (e.g. remote I/O data packets) over other packet types.

L

LD

(*ladder diagram*) A programming language that represents instructions to be executed as graphical diagrams very similar to electrical diagrams (contacts, coils, etc.).

legacy remote I/O

A Quantum remote I/O system using coaxial cabling and terminators.

literal value of an integer

A value used to enter integer values in the decimal system. Values may be preceded by the "+" and "-" signs. Underscore signs (_) separating numbers are not significant.

Example:

```
-12, 0, 123_456, +986
```

local rack

A Quantum rack containing the controller, a power supply, and an Ethernet remote I/O head module. A local rack consists of 1 or 2 racks — the main rack (containing the remote I/O head module) and an optional extended rack. A Quantum Ethernet remote I/O network requires 1 local rack on the main ring.

local slave

A functionality offered by Schneider Electric EtherNet/IP communication modules that allows a scanner to take the role of an adapter. The local slave enables the module to publish data via implicit messaging connections. Local slave is typically used in peer-to-peer exchanges between PLCs.

M

MAST

A master processor task that is run through its programming software. The MAST task has 2 sections:

- IN: Inputs are copied to the IN section before execution of the MAST task.
- OUT: Outputs are copied to the OUT section after execution of the MAST task.

MIB

(*management information base*) A virtual database used for managing the objects in a communications network. See SNMP.

Modbus

An application-layer messaging protocol. Modbus provides client and server communications between devices connected on different types of buses or networks. Modbus offers many services specified by function codes.

Modbus/TCP

(*Modbus over TCP protocol*) A Modbus variant used for communications over TCP/IP networks.

multicast

A special form of broadcast where copies of the packet are delivered to only a specified subset of network destinations. Implicit messaging typically uses multicast format for communications in an EtherNet/IP network.

N

network

There are 2 meanings:
- In a ladder diagram:
  A set of interconnected graphic elements. The scope of a network is local, concerning the organizational unit (section) of the program containing the network.
- With expert communication modules:
  A set of stations that intercommunicate. The term *network* is also used to define a group interconnected graphic elements. This group then makes up part of a program that may comprise a group of networks.

NIM

(*network interface module*) A NIM resides in the first position on an STB island (leftmost on the physical setup). The NIM provides the interface between the I/O modules and the fieldbus master. It is the only module on the island that is fieldbus-dependent — a different NIM is available for each fieldbus.

NTP

(*network time protocol*) Protocol for synchronizing computer system clocks. The protocol uses a jitter buffer to resist the effects of variable latency.

O

O->T

(*originator to target*) See *originator* and *target*.

operation network

An Ethernet-based network containing operator tools (SCADA, client PC, printers, batch tools, EMS, etc.). PLCs are connected directly or through routing of the inter-controller network. This network is part of the control network.

originator

In EtherNet/IP, a device is considered the originator when it initiates a CIP connection for implicit or explicit messaging communications or when it initiates a message request for un-connected explicit messaging.

OS Loader

Firmware upgrade tool for Quantum hardware.

P

PLC

programmable logic controller. The PLC is the brain of an industrial manufacturing process. It automates a process as opposed to relay control systems. PLCs are computers suited to survive the harsh conditions of the industrial environment.

port 502

Port 502 of the TCP/IP stack is the well-known port that is reserved for Modbus communications.

port mirroring

In this mode, data traffic that is related to the source port on a network switch is copied to another destination port. This allows a connected management tool to monitor and analyze the traffic.

NOTE: In port mirroring mode, the SERVICE port acts like a read-only port. That is, you cannot access devices (ping, connection to Unity Pro, etc.) through the SERVICE port on the 140 CRP 312 00 and 140 CRA 312 00.

Q

QoS

(*quality of service*) The practice of assigning different priorities to traffic types for the purpose of regulating data flow on the network. In an industrial network, QoS is used to provide a predictable level of network performance.

Quantum Ethernet I/O device

These devices in Quantum Ethernet I/O systems provide automatic network recovery and deterministic remote I/O performance. The time it takes to resolve a remote I/O logic scan can be calculated, and the system can recover quickly from a communication disruption. Quantum Ethernet I/O devices include:

- local rack (with an Ethernet remote I/O head module)
- remote I/O drop (with an Ethernet adapter module)
- DRS pre-configured switch

R

rack optimized connection

Data from multiple I/O modules consolidated in a single data packet to be presented to the scanner in an implicit message in an EtherNet/IP network.

remote I/O drop

One of the 3 types of remote I/O devices in an Ethernet remote I/O network. A remote I/O drop is a Quantum rack of I/O modules that are connected to an Ethernet remote I/O network and managed by an Ethernet remote adapter module. A drop can be a single rack or a rack with an extension rack.

remote I/O main ring

The main ring of an Ethernet remote I/O network. The ring contains remote I/O devices and a local rack (containing a controller, a power supply module, and an Ethernet remote I/O head module).

remote I/O network

An Ethernet-based network that contains 1 standalone PLC or one Hot Standby system and remote I/O devices. There are 3 types of remote I/O devices: a local rack, a remote I/O drop, and a ConneXium extended dual-ring switch (DRS). Distributed I/O devices may also participate in a remote I/O network via connection to DRSs.

RPI

(requested packet interval) The time period between cyclic data transmissions requested by the scanner. EtherNet/IP devices publish data at the rate specified by the RPI assigned to them by the scanner, and they receive message requests from the scanner at each RPI.

RSTP

(*rapid spanning tree protocol*) A protocol that allows a network design to include spare (redundant) links to provide automatic backup paths if an active link stops working, without the need for loops or manual enabling/disabling of backup links.

S

scanner

The originator of I/O connection requests for implicit messaging in EtherNet/IP, and message requests for Modbus TCP.

scanner class device

An EtherNet/IP node capable of originating exchanges of I/O with other nodes in the network.

service port

A dedicated Ethernet port on the Quantum Ethernet remote I/O modules. The port may support 3 major functions (depending on the module type):

- port mirroring — for diagnostic use
- access — for connecting HMI/Unity Pro/ConneXview to the PLC
- extended — to extend the device network to another subnet
- disabled — disables the port, no traffic is forwarded in this mode

SFC

(*sequential function chart*) An IEC programming language that graphically represents, in a structured manner, the operation of a sequential PLC. This graphical description of the PLC's sequential behavior and of the various resulting situations is created using simple graphic symbols.

simple daisy chain loop

A daisy chain loop that contains remote I/O devices only (no switches or distributed I/O devices). This topology consists of a local rack (containing a remote I/O head module), and 1 or more remote I/O drops (each drop containing a remote I/O adapter module).

SNMP

(*simple network management protocol*) Protocol used in network management systems to monitor network-attached devices for events. The protocol is part of the internet protocol suite (IP) as defined by the internet engineering task force (IETF), which consists of network management guidelines, including an application layer protocol, a database schema, and a set of data objects.

SNTP

(*simple network time protocol*) See *NTP*.

SOE

(*sequence of events*) The process of determining the order of events in an industrial system and correlating those events to a real-time clock.

ST

(*structured text*) A structured, developed language similar to computer programming languages. It can be used to organize a series of instructions.

sub-ring

An Ethernet-based network with a loop attached to the main ring, via a DRS. A sub-ring may contain either remote I/O or distributed I/O devices.

subnet mask

The 32-bit value used to hide (or mask) the network portion of the IP address and thereby reveal the host address of a device on a network using the IP protocol.

switch

A multi-port device used to segment the network and limit the likelihood of collisions. Packets are filtered or forwarded based upon their source and destination addresses. Switches are capable of full-duplex operation and provide full network bandwidth to each port. A switch can have different input/output speeds (for example, 10, 100 or 1000 Mb/s). Switches are considered OSI layer 2 (data link layer) devices.

T

T->O

(*target to originator*) See *target* and *originator*.

target

In EtherNet/IP, a device that is the recipient of a connection request for implicit or explicit messaging communications, or when it is the recipient of a message request for un-connected explicit messaging.

TCP

(*transmission control protocol*) A key protocol of the internet protocol suite that supports connection-oriented communications, by establishing the connection necessary to transmit an ordered sequence of data over the same communication path.

TCP/IP

Also known as *internet protocol suite*, TCP/IP is a collection of protocols used to conduct transactions on a network. The suite takes its name from 2 commonly used protocols: transmission control protocol and internet protocol. TCP/IP is a connection-oriented protocol that is used by Modbus TCP and EtherNet/IP for explicit messaging.

TOD

(*time of day*) The `TOD` type, encoded in BCD in a 32-bit format, contains the following information:

- the hour encoded in an 8-bit field
- the minutes encoded in an 8-bit field
- the seconds encoded in an 8-bit field

NOTE: The 8 least significant bits are not used.

The TOD type is entered as follows: **`TOD#`**`<Hour>`**`:`**`<Minutes>`**`:`**`<Seconds>`

This table shows the upper/lower limits of each field:

Field	Limits	Comment
Hour	[00,23]	The leading 0 is displayed; it can be omitted during data entry.
Minute	[00,59]	The leading 0 is displayed; it can be omitted during data entry.
Second	[00,59]	The leading 0 is displayed; it can be omitted during data entry.

Example: `TOD#23:59:45`.

TR

(*transparent ready*) Web-enabled power distribution equipment, including medium- and low-voltage switch gear, switchboards, panel boards, motor control centers, and unit substations. Transparent Ready equipment allows you to access metering and equipment status from any PC on the network, using a standard web browser.

trap

An event directed by an SNMP agent that indicates one of the following:
- a change has occurred in the status of an agent
- an unauthorized SNMP manager device has attempted to get data from, or change data on, an SNMP agent

U

UDP

(*user datagram protocol*) A transport layer protocol that supports connectionless communications. Applications running on networked nodes can use UDP to send datagrams to one another. UDP does not always deliver datagrams as reliable or ordered as those delivered by TCP. However, by avoiding the overhead required for TCP, UDP is faster. UDP may be the preferred protocol for time-sensitive applications, where dropped datagrams are preferable to delayed datagrams. UDP is the primary transport for implicit messaging in EtherNet/IP.

V

variable

Memory entity of type `BOOL`, `WORD`, `DWORD`, etc., whose contents can be modified by the program currently running.

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